THE BEEF NUTRIENT DATABASE IMPROVEMENT STUDY: RETAIL CUTS FROM THE LOIN AND ROUND

A Thesis

by

HALEY LEE GRIMES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2012

Major Subject: Animal Science

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Approved by:

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	Kerri B. Harris
Committee Member,	Stephen B. Smith
Head of Department,	H. Russell Cross

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ABSTRACT

The Beef Nutrient Database Improvement Study: Retail Cuts

From the Loin and Round. (May 2012)

Haley Lee Grimes, B.S., Texas A&M University

Co-Chairs of Advisory Committee: Dr. Jeffrey W. Savell
Dr. Kerri B. Harris

The objective of this study was to update the existing nutritional data available in the USDA National Nutrient Database for Standard Reference by providing revised nutritional information on the round and loin cuts evaluated in Phase III of the Nutrient Database Improvement Project. A total of 20 carcasses were selected from three packing plants across the United States, and round and loin subprimals from these carcasses were collected and transported to Texas A&M University. These subprimals were fabricated 14 to 21 d postmortem, dissected either raw or cooked, and divided to determine the amount of separable lean, separable fat, and refuse amounts per cut. Separable lean from these cuts was homogenized and proximate analyses were conducted in order to determine percent total chemical fat, protein, moisture, and ash.

Cooking yields and fat retention values were determined for the cuts that were grilled and roasted. Cuts with external fat had higher cooking yields than cuts with external fat removed. Cuts with external fat had higher fat retention values than the cuts with no external fat. Dissection data indicated that cuts trimmed to lower levels of

external fat had the highest values for percent lean and the lowest values for percent seam and external fat and bone-in cuts had the lowest values for percent lean and the highest values for percent refuse. Proximate analyses indicated a decrease in percent moisture as the percentage of total chemical fat increased. Also, round cuts evaluated in the study contained a lower percentage of total chemical fat than loin cuts on a raw basis. When total chemical fat was stratified by USDA quality grade, it was evident that there was a clear separation between upper Choice, lower Choice, and Select cuts.

Data resulting from this study will be used to update the existing nutritional database and will provide a current nutritional profile for beef loin and round products.

DEDICATION

To my husband and my mother, Joshua Grimes and Diane Deitzel. Thank you both for your love and support throughout this entire endeavor and my graduate school career. Words cannot begin to express how truly grateful I am for the both of you.

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individual I am today and I hope to one day inspire my children in the way you inspire me. Pap Pap and Grandma, you are truly an inspiration. Thank you for all of your guidance and for helping me develop a love for agriculture and all that it has to offer. I love you all so very much.

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1. INTRODUCTION

In recent years, there has been a nationwide demand for dependable, accurate nutritional information for food products in today's marketplace. As consumers push for more information on the food products they consume, there is a great need for updating the existing information to provide consumers with an extensive, current, and accurate nutritional profile for all food products. One category of food that has come under increased scrutiny in regards to nutrition is meat, and more specifically, beef products. As health conscious consumers demand beef that meets low fat, organic, or lean claims, there is a greater need for a nutritional database that reflects the product that is currently in the market.

The beef industry had made considerable strides in attempts to keep up with the dynamic market. Some of their efforts include new cuts developed for beef alternative merchandizing (BAM) as well as contracting studies, like this one, to gain information on the nutritional profile of beef retail cuts. From these studies, the National Cattlemen's Beef Association has determined that there are twenty-nine cuts of beef that are considered healthy based on guidelines set by the United States government (NCBA, 2005). These guidelines define a lean cut at containing less than 10 g total fat, 4.5 g or less saturated fat, and less that 95 mg cholesterol per 100 g (USDA, 2011). It is crucial that the National Nutrient Database remains responsive to changes and updates as new

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This thesis follows the style of *Meat Science*.

products are developed and marketed and production and merchandizing practices change over time. With this information, consumers are better equipped to make educated decisions on their beef purchases.

This study was created to update the existing nutritional profile for beef retail cuts available in the National Nutrient Database for Standard Reference. This project was funded in part by The Beef Check-off and was a collaborative effort by Texas A&M University, Texas Tech University, Colorado State University, the National Cattlemen's Beef Association, and the Nutrient Data Laboratory. The objectives of the study were to collect and analyze representative retail cuts from the beef loin and round, to compile updated proximate data, and to update the existing information on the round and loin cuts in the USDA National Nutrient Database for Standard Reference. The results reported and discussed in this thesis are based only on the results from the data collected by Texas A&M University. The information reported by Texas A&M University will be compiled with individual data from the two collaborating universities and will be published in the USDA National Nutrient Database for Standard Reference.

2. REVIEW OF LITERATURE

The United States Department of Agriculture (USDA) is the main entity that handles nutritional profiling for the wide variety of agricultural goods sold to consumers. For over a century, the USDA has worked to update and define the nutritional information of these foods. Their standard database is the USDA National Nutrient Database for Standard Reference; more commonly referred to as SR, and includes nutritional information for over 7,900 foods (USDA, 2011). This information was originally published in the USDA's Agricultural Handbook 8. In this handbook, nutritional information was compiled and updated to reflect changes in the nutritive values of food products (USDA, 1990). This handbook has since been replaced by the USDA's SR and provides usable, up-to-date, information on the nutrient composition of meat products that is accessed and utilized by healthcare professionals, food service companies, dietitians, and other sectors in the agricultural industry (Jones et al., 1992a).

Several studies conducted have served to continue to update the food composition values and information on beef products. Woolsey and Paul (1969) was conducted in order to evaluate external fat cover influence on raw and cooked beef as it pertains to fat and moisture content. The results of this early study indicated that moisture content of beef decreases as fat increases and there was little resolve on how external fat trimming influenced the amount of fat content. Thus, this study established a need for further evaluation of the role that external fat plays on the total fat found in beef retail cuts. Coleman et al. (1988) further evaluated the interaction between fat trim levels

and total fat content in beef. This study focused on the fat content of cooked beef retail cuts with and without external fat as it pertained to sensory characteristics. It was determined that those cuts containing a larger amount of external fat had higher fat retention values and higher fat content then those with lower amounts of external fat cover. This study revealed that removing external fat from beef cuts prior to cooking reduces overall fat content in cooked beef retail cuts.

National consumer retail beef studies are another group of studies that have made a large impact on the way the market views the role of external fat on consumer acceptance. Cross et al. (1986) and Savell et al. (1989) were conducted in order to determine consumer preference and marketing of beef cuts with various external fat trim levels. Earlier work conducted by Cross et al. (1986) encouraged the market to produce beef retail cuts with an external fat thickness of no more than 0.64 cm. Savell et al. (1989) updated this information by reevaluating consumer acceptability of beef cuts offered in the marketplace. They focused on the correlation between trim level, taste, and price as it pertained to consumer preferences. This study determined that consumers during this time felt that cuts that were trimmed completely free of external fat were healthier and produced less waste. "These issues, taste, price, and leanness, greatly influence how consumers rate beef, with taste being a positive influence, and price and fatness being negative influences" (Savell et al., 1989). Projections from this study indicated that, by marketing trimmer retail cuts, sales of beef would increase significantly.

In 1992 a series of studies performed by Jones et al. (1992a,b,c) further evaluated the interaction between fat trim levels and the composition of beef retail cuts by evaluating cuts trimmed to 0.6 cm and 0.0 cm. At this time, consumers were demanding beef products with more lean and less fat. "Consumers concern over dietary fat has been responsible for emphasis on the production of leaner retail beef cuts" (Jones et al., 1992a). Prior to this series of studies, Agricultural Handbook 8-13 only listed information on cuts with 1.3 cm fat, but the ongoing research conducted on the nutrient composition of beef cuts was used to constantly update the handbook as information on further trimmed cuts became available. The studies conducted by Jones et al. (1992a,b,c) evaluated the composition of beef cuts trimmed as it pertained to the percentage of separable tissue components, fat composition, fat retention, and cooking yields of beef retail cuts as they were presented to the 1990s consumer. They discovered that, by producing more boneless beef retail cuts, they could reduce the amount of intermuscular fat that was found in traditional bone in cuts without adversely affecting consumer appeal. This study also determined that, by trimming beef retail cuts to 0.0 cm of external fat prior to cooking, they could reduce the amount of waste produced, increase the percentage of lean, and decrease the percentage of separable fat found in beef retail cuts. In addition to the advantages already stated, trends from these studies indicated that cuts trimmed to lower external fat amounts before cooking result in lower chemical fat content and fat retention values. However, removing external fat also decreased the values for cooking yield. The results of this study indicated that the nutritional information available at that time was not truly reflective of the trimmer cuts that were

available in the marketplace. These studies caused a revision to Agricultural Handbook 8-13 (USDA, 1990). "As more up-to-date information becomes available on closer or completely trimmed retail cuts, it is necessary for the USDA to modernize its nutrient information sources and modify existing regulations concerning nutrition labeling and labeling claims" (Jones et al., 1992a).

More recent studies conducted by Wahrmund-Wyle et al. (2000a,b) served to further update the information on beef retail cut composition. These studies assisted in updating information on separable tissue components and cooking yield for beef cuts at their current external fat trim levels. Results concluded that as fat cover decreased, percentage separable external fat decreased and percentage separable lean of cooked cuts increased. Furthermore, they determined that trimming cuts to lower levels of external fat did not significantly affect the amounts of chemical fat, protein, moisture, or ash present in the cut. The study indicated that cuts available in 1998 generally had less chemical fat and lipid content than what was reported in Agricultural Handbook 8-13 at that time.

Numerous Market Basket Surveys are routinely conducted in order to better determine the type and characteristics of beef products that are currently sold in the retail sector of the beef industry. The objectives of these studies were to determine the current amounts of external fat on beef retail cuts and to evaluate the amounts of separable and chemical fat levels of cuts to update information available on the beef retail cuts currently available to consumers. Savell et al. (1991) concluded that even though levels of external fat were lower than previously reported, there were still issues with seam fat

in beef cuts available in the retail case. This study indicated that retailers had reduced the level of external fat to 0.38 cm, which indicated that the market had met consumer demands for leaner beef. Mason et al. (2009) focused on beef cuts sold at the retail level, their composition, and the change of external fat thickness from previous studies to reflect what is sold currently. They determined that as total separable fat decreased, separable lean increased and that generally those cuts that were trimmed to lower levels had higher levels of separable lean than those with higher amounts of external fat. After reviewing the results of the previous market basket survey conducted by Savell et al. (1991), Mason et al. (2009) concluded that the beef in the current survey contained less separable and external fat.

Within the last year, articles have been published that emphasize the shift to leaner beef cuts in the marketplace. McNeill et al. (2011) discussed the reduction of fat content in beef products over the last thirty years and the more recent updates to the nutrient database concerning beef products. While taste may be the main reason that most consumers eat beef, the fat content of the beef may be a reason as to why beef makes up such a small amount of the average American's diet (McNeill et al., 2011). McNeill et al. (2011) attributed the reduction in fat content to a shift in the genetic selection and breeding of beef cattle and the increased trimming of fat on cuts available in the retail case. Dixon et al. (2012) evaluated the ideal aging period and nutrient profile of beef cuts from the round. The results of the study determined that all round muscles evaluated in the study were classified as lean or extra lean according to USDA guidelines (Dixon et al., 2012). Results from the study also suggested that the lean

classification of the cuts should be used as a marketing statement for round products in the food service and retail sectors of the industry. While it is clear that the amount of fat in beef cuts has decreased, the beef industry's current challenge is to update the existing nutrient information and communicate, to consumers, the availability of lean beef in the marketplace.

The trends that appear in these consumer retail beef studies, market basket surveys, and additional research reflect a change in consumer preferences and, more importantly, a change in the beef products being sold in the market today. The constant change in consumer preferences, most notably focused on external fat trim, insists that the existing nutritional database must be continuously updated to reflect changes in the industry. "For a majority of the retail cuts represented in the National Nutrient Database, nutrient information is available for cuts with external fat thickness measurements of 1.27 cm, 0.6 cm, 0.3 cm, and 0.0 cm" (Mason et al., 2009). The revisions already made are the direct result of studies that determined the shift from fat trim levels in the original Agricultural Handbook 8-13 of 1.3 cm, to external fat thickness levels of 0.6 cm, 0.3 cm, and 0.0 cm. These studies assisted in the USDA's efforts to update the existing nutritional composition values of beef, which resulted in four new versions of the Agricultural Handbook No. 8 (Mason et al., 2009). Therefore, it is necessary to maintain an evolving database for nutritional information as new information becomes available to ensure that consumers, healthcare professionals, food service companies, and other government agencies have the most current, accurate information on the beef available in the industry today.

3. MATERIALS AND METHODS

3.1. Product selection

Twenty carcasses were selected from three packing plants located across the United States (Green Bay, WI; Corpus Christi, TX; and Tolleson, AZ) based on specifications including age (based on both skeletal and lean maturity), native or dairy classification, USDA yield and quality grades (USDA, 1997), and sex (Table 1). In addition to these specifications, carcasses also had to meet specified weight requirements (318 to 431 kg for steer and dairy carcasses and 295 to 408 kg for heifer carcasses), be A maturity, have a hump height less than 10.2 cm, and be free of major defects (bruises, dark cutting, blood splash, etc.). Carcass data were collected for each carcass selected for this study (Table 2). Due to the types of subprimals needed, two carcasses were selected for each animal number. These duplicate carcasses were labeled carcass A and B. Short loins were collected from carcass A and strip loins, tenderloins, top rounds and eye of rounds were collected from carcass B. Duplicate carcasses were selected to be as close in marbling scores as possible and fell into the outlined specifications for all other carcass characteristics. Once carcasses were identified and confirmed as meeting the outlined specifications by university personnel, carcasses and subprimals were tagged for identification during fabrication and packaging.

3.2. Product collection

After carcasses were selected for meeting the project specifications, carcasses and subprimals were tagged. Carcasses A and B were identified and right and left sides were tagged individually for later identification. Each subprimal was tagged with a tag indicating animal number, carcass side, and indicated whether the carcass was designated as carcass A or B. All tags were secured and carcasses continued through fabrication based on the manufacturing practices of each plant. University personnel were stationed at each fabrication line in order to identify and collect each subprimal. Each subprimal was fabricated into its respective Institutional Meat Purchase Specifications (IMPS) (USDA, 2010) number as outlined in the project's protocol (short loins-IMPS #174, strip loins- IMPS #180, tenderloins- IMPS # 189A, top rounds- IMPS #168, and eye of rounds- IMPS #171C). After fabrication, the subprimals were then vacuum packaged and boxed and were held in refrigeration temperatures (0-4°C) until they were transported to Texas A&M University via refrigerated truck. Temperatures were verified for holding at the plant, during transportation, and during storage at the university to ensure that the product was kept under refrigeration (0-4°C).

3.3. Fabrication

Upon arrival at the university, subprimals were held in refrigeration (0-4°C) and were aged for 14 to 21 d postmortem prior to fabrication. After aging was complete, each subprimal was further fabricated into steaks and roasts and trimmed according to established specifications outlined by the sampling matrix.

3.3.1. Porterhouse steaks and T-bone steaks. Porterhouse steaks and T-bone steaks were procured from the shortloins (Carcass A) selected for this study. Before fabrication, the subprimal weight was recorded to the nearest 0.1 g. The tails on the short loins were trimmed to 2.5 cm. The posterior end of the short loin was faced before cutting steaks. The facing scraps were weighed and recorded to the nearest 0.1 g. Porterhouse and T-bone steaks were cut and numbered, posterior to anterior, and were cut to be 2.5 cm in thickness. This measurement was verified by using a standard fat probe in order to ensure consistency in thickness of the steaks. The external fat on all porterhouse and T-bone steaks was trimmed to 0.3 cm. If tails were present on the steaks, they were also trimmed but remained on the steaks. Also, if present, the *Longissimus costarum* remained on the steak, and the external fat was trimmed to 0.3 cm. Total fat produced from the subprimal was weighed and recorded to the nearest 0.1 g. Porterhouse and T-bone steaks were identified based on a measurement of the tenderloin width. Porterhouse steaks were identified as having a minimum tenderloin width (measured perpendicular to the transverse process) of 3.2 cm and T-bone steaks were identified to have a tenderloin thickness (measured as described previously) of 1.3 cm to 3.2 cm. Any steaks with a tenderloin width less than 1.3 cm were weighed and recorded to the nearest 0.1 g, but were not further analyzed in this study. Anterior wedge scrap and bone dust for each subprimal were weighed and recorded to the nearest 0.1 g.

3.3.2. Tenderloin steaks and tenderloin roasts. Tenderloin steaks and roasts were procured from the full tenderloins (Carcass B) selected for this study. Before fabrication, the subprimal weight was recorded to the nearest 0.1 g. External fat on the full

tenderloins was trimmed to 0.0 cm and silver skin was removed. Total fat produced from the subprimal was weighed and recorded to the nearest 0.1 g. The tail of the tenderloin was removed at 2.5 cm in diameter, and the side muscle was removed from the tenderloin. These pieces were weighed and recorded to the nearest 0.1 g. Three center cut steaks, 3.8 cm in thickness, were removed from the center of the tenderloin. The remaining butt and tail sections from the tenderloin were identified as the tenderloin roasts. The butt tender/roast was identified as roast number 1 and the middle roast was identified as roast number 2. Steaks were numbered 1 through 3 from the posterior end to the anterior end.

3.3.3. Top loin steaks bnls (0.0 cm & 0.3 cm). Top loin steaks (both 0.0 cm and 0.3 cm) were procured from the strip loins (Carcass B) selected for this study. Before fabrication, the subprimal weight was recorded to the nearest 0.1 g. The anterior end of the strip loin was faced prior to cutting steaks. The facing scraps were weighed and recorded to the nearest 0.1 g. Steaks were cut 2.5 cm in thickness and were cut anterior to posterior. External fat on the top loin steaks was cut to alternate between 0.0 cm to 0.3 cm external fat trim levels. Total fat produced from the subprimal was weighed and recorded to the nearest 0.1 g. Steaks were numbered from the anterior end to the posterior end, starting at 1 and counting upwards for each steak. The trim level for the first steak of each loin was indicated in the sampling matrix to ensure proper alternation and randomization of trim levels across strip loins (Table 3). Steaks with 0.0 cm external fat trim were cut to have no tail. Steaks with 0.3 cm trim were cut to have a 1.3 cm tail. Vein steaks were identified and were defined as those steaks with *Gluteus medius*

present on both sides of the steak. Vein steaks were not further analyzed in this study. Vein steaks and posterior wedge scrap for each subprimal were weighed and recorded to the nearest 0.1 g.

3.3.4. Eye of round steaks and roasts. Eye of round steaks and roasts were procured from the eye of rounds (Carcass B) selected for this study. Before fabrication, the subprimal weight was recorded to the nearest 0.1 g. External fat was trimmed to 0.0 cm and the silver skin on the anterior end of the subprimal was removed. Total fat produced from the subprimal was weighed and recorded to the nearest 0.1 g. The subprimal was cut in half. Starting at the cut surface of each half, three 1.3 cm steaks were removed. The two remaining ends from the eye of round were identified as the eye of round roasts. The eye of round steaks and roasts were numbered. The anterior roast was identified as roast number 1 and the posterior roast was identified as roast number 2. Steaks were numbered 1 through 6 from the anterior end to the posterior end.

3.3.5. Top round steaks and roasts. Top round steaks and roasts were procured from the whole top rounds, cap-on (Carcass B) selected for this study. Before fabrication, the subprimal weight was recorded to the nearest 0.1 g. The *Gracilis*, *Adductor*, *Pectineus*, and *Sartorius* were weighed, recorded (to the nearest 0.1 g), and removed from the top round. The top round external fat was then trimmed to 0.0 cm. Total fat produced from the subprimal was weighed and recorded to the nearest 0.1 g. The anterior (aitch bone) surface was faced before steak cutting. This anterior facing scrap was weighed and recorded to the nearest 0.1 g. Four top round steaks 1.9 cm in thickness were removed starting from the anterior side of the top round. One

top round roast 5.1 cm in thickness was cut in the same manner as the top round steaks. The remaining portion of the top round was divided equally into two "wedge-shaped" roasts by making a cut perpendicular to the anterior face of the subprimal. The top round steaks and roasts were numbered. The anterior roast was identified as roast number 1 and the posterior (wedge) roasts were identified as roast numbers 2 and 3. Steaks were numbered 1 through 4 from the anterior end to the posterior end.

All cuts were weighed, recorded (to the nearest 0.1 g), tagged, and packaged individually in high barrier vacuum bags. Once packaged, the cuts were held in frozen storage (-18°C) until further cooking of cooked cuts and dissection of both raw and cooked cuts.

3.4. Cooking

Based on the established matrix, a portion of the cuts were grilled or roasted and data was recorded to identify cook yields and times (Table 4). Before cooking, the frozen raw samples were tempered in a single layer in refrigeration (0-4°C) for 24-48 h. After tempering was complete, each cut was removed from the package, and the temperature of the cut was recorded. Each individual cut was then blotted with a towel to remove any purge and was weighed and recorded to the nearest 0.1 g. A type T thermocouple was then placed in the geometric center of each steak or roast to monitor temperatures during cooking. Porterhouse steaks, T-bone steaks, tenderloin steaks, and top loin steaks (both 0.0 cm and 0.3 cm) were grilled using a Salton two-sided electric grill (model No. GRP99). Tenderloin roasts were roasted using a Calphalon or similar

non-stick roasting pan. Cooking times, weights, and temperatures were recorded for each individual cut.

3.4.1. Grilling. Before cooking, each grill was preheated for approximately 10 min. Once the grill surface temperature stabilized at 195°C, grill temperature was recorded using an infrared thermometer. Steaks then were placed, evenly spaced, in the center of the cooking grate and, the lid was closed ensuring that the grates came in contact with the meat. Each steak was cooked to an internal temperature of 70°C. The steaks then were immediately removed from the grill, and a removal time and temperature were recorded. Cooked weight of each steak was recorded to the nearest 0.1 g immediately after it was removed from the grill. All steaks then were transferred to a wire rack and were stored uncovered, under refrigeration (0-4°C) for at least 12 h before dissection. All identification tags remained with each steak throughout the entire process to maintain product identification.

3.4.2. Roasting. Before cooking, each oven was preheated for 10 min at 160°C. Oven temperature was recorded using an infrared thermometer. Each roast was placed in the center of the rack in the roasting pan. The pan then was placed in the center of the oven uncovered. Roasts were cooked to an internal temperature of 60°C. The roasts then were immediately removed from the oven, and removal time and removal temperature were recorded. Roasts then were removed from the pan rack and placed on a wire rack. Temperature then was monitored until a peak temperature was reached. The peak temperature and the time this temperature was achieved were recorded. Cooked weight for each roast was recorded to the nearest 0.1 g at 30 min after removal from the oven.

Once this weight was recorded, roasts were stored uncovered, under refrigeration (0-4°C) for at least 12 h before dissection. All identification tags remained with each steak throughout the entire process to maintain product identification.

3.4.3. Cooked yields and fat retention values. Cooked yield was determined for each retail cut type using the following calculation: % cooked yield = (cooked weight/raw weight) x 100. Fat retention values were determined using the following calculation (Wahrmund-Wyle et al., 2000): % fat retention = (% fat in cooked lean/% fat in raw lean) x % cooked yield.

3.5. Dissection

Before dissection, all frozen raw samples were tempered in a single layer under refrigeration (0-4°C) for 24-48 h, and all cooked samples were tempered in a single layer under refrigeration (0-4°C) for at least 12 h post cooking. Tempering date, time, and location were recorded. After tempering was complete, each cut was removed from the package and temperature of the cut was recorded. Each individual cut was then blotted with a towel to remove any purge and was weighed and recorded to the nearest 0.1 g. Each individual steak or roast was dissected, and weights were recorded to the nearest 0.1 g for the amount of separable lean, external fat, seam fat, and refuse amounts per cut. For all cuts, external fat was identified as any fat located on the outer surface of the cut, and seam fat was identified as any fat deposited between muscles in any cut. Lip lean and lip fat weights were recorded to the nearest 0.1 g for top loin steaks (0.3 cm). The lip was identified as the portion past the curvature of the natural seam. Lip lean weight

included all lean from the lip, and lip fat included all of the fat from the lip. Once weighed, lip lean was combined with total separable lean and lip fat was combined with seam fat prior to homogenization. At the completion of fabrication for each cut, separable lean was placed into Ziploc® bags with proper identification and was held under refrigerated temperatures (0-4°C) for same-day homogenization. Cooked and raw seam fat and external fat remained separate and were placed into Ziploc® bags with proper identification. These bags were frozen at -80°C for later homogenization.

3.6. Homogenization

Homogenization of beef samples was performed the same day as dissection. Before homogenization, Ziploc® freezer bags and Whirl-pak bags were labeled with weatherproof labels for storage of homogenate during freezer storage. After dissection, samples were held under refrigeration (0-4°C) until homogenization was performed. Before homogenization, each individual steak was combined with the rest of the steaks from the same individual subprimal and animal number. After dissection, each individual sample was removed from refrigeration, cubed into small chunks, and was submerged into a 1.9 liter insulated bucket. A start time was recorded and samples remained submerged under liquid nitrogen until the samples were completely frozen. Samples were drained of any excess liquid nitrogen and checked to ensure all meat was properly frozen. After draining, samples were placed into a large stainless steel mixing bowl and transferred into a Robot Coupe Blixer 7 BX 6V batch processor (M1-45-3). Samples were then homogenized for 10 s at 1500 rpm and then further homogenized for

30 s at 3500 rpm. At this point, samples were checked to ensure proper homogenization was achieved. Samples were then transferred from the processor to a large stainless steel mixing bowl, and any additional homogenate remaining on the processor bowl or lid was removed and added to the stainless steel bowl. Once all sample was placed in the mixing bowl, a stainless steel spoon was used to stir the sample starting from the outer edge of the bowl, moving back toward the center of the bowl, and then back again toward the outer edge of the bowl in a steady motion for 30 s. Pre-labeled Ziploc® freezer bags and Whirl-pak bags then were filled with homogenate from each sample and weighed. Sample was weighed and bagged for the following aliquots: 60 g for proximate analysis, 100 g each for proximate back-up and archive, and 450 g for composite. Any remaining sample was weighed and placed in a Ziploc® freezer bag labeled "Extra Homogenate". For samples containing a smaller amount of homogenate, minimum weights of homogenate were weighed for the following aliquots: 60 g for proximate analysis, 200 g for composite, and the remaining homogenate was divided evenly between back-up and archive. Once each sample was homogenized and bagged, a stop time was recorded and each Ziploc® freezer bag and Whirl-pak bag was double bagged and placed in a -80°C freezer until proximate analysis was conducted.

Utensils and equipment were cleaned between each sample and nitrile gloves were worn to prevent any contamination between samples. Also, due to the sensitivity of nutrients, all homogenization was conducted in the absence of direct light to prevent any nutrient loss of the sample.

3.7. Proximate analyses

Proximate analyses were conducted on each sample to derive the percentage of fat, protein, moisture, and ash per sample. All proximate analyses conducted at Texas A&M University were conducted in triplicate for each individual sample.

3.7.1. Fat. Total fat analysis was conducted using the modified Folch et al. (1957) method of determining fat content. Approximately 0.5 g of sample was weighed into a glass test tube. Approximately 15 mL of chloroform:methanol (2:1) then was added to the tube, and samples were placed in a shaker for 10 min to ensure proper lipid extraction from the sample. The sample then was filtered through 2.4 cm filter paper and transferred into a second glass test tube. The original test tube and filtering apparatus were rinsed with approximately 20 mL of chloroform:methanol into the second test tube. After filtering, 8 mL of 0.74% KCl was added to each test tube and was vortexed for 30 s. The sample was transferred into a 50 mL graduated cylinder and refrigerated (0-4°C) for at least 12 h. After refrigeration, the volume of the chloroform:methanol layer was recorded and the KCl layer was suctioned out of the graduated cylinder. A volume of 10 mL of the chloroform:methanol layer was transferred to a pre-dried glass scintillation vial, and the chloroform:methanol was evaporated using a nitrogen gas evaporator. The vials were dried in an oven at 100°C for 10 min to ensure all excess moisture was removed. Scintillation vials were weighed and weights were recorded. Percentage of total fat content was determined using the following calculation: % lipid = [(total volume of chloroform:methanol/10 x final lipid weight)/sample weight] x 100.

3.7.2. Protein. Protein analysis was conducted using a rapid N cube (Elementar Analysensysteme GmbH, Hanau, Germany) nitrogen analyzer to determine percent protein. Blank and aspartic acid standards were used to calibrate the analyzer daily as outlined in the operators' instruction manual. Approximately 250 mg of each sample was weighed into 50*50 mm tin foil weigh boats and was formed into a pellet. Samples were placed in the rapid N cube analyzer and nitrogen analysis was conducted. Percentage protein content was determined using the following calculation: % protein = (N x 6.25).

3.7.3. Moisture. Moisture analysis was conducted using the AOAC (1990) method 950.46. Approximately 5 g sample was weighed in a pre-dried, pre-weighed, and pre-labeled 57 mm aluminum tin. Samples were dried in an oven at 100°C for 16-18 h. The samples were removed and cooled in desiccators. Tins were weighed and weights were recorded. Percentage moisture content was determined using the following calculation: % moisture = [(wet weight-dry weight)/ wet weight] x 100.

3.7.4. Ash. Ash analysis was conducted using the AOAC (1990) ash oven method. After completing moisture analysis, tins were saved and used for ash analysis. After weighing the samples for moisture, the samples were placed in a muffle furnace for 10.5 h at 600°C. The samples were removed from the furnace and cooled in desiccators. Tins were weighed and weights were recorded. Percentage ash content was determined using the following calculation: % ash = (ashed weight/wet weight) x 100.

3.7.5. Quality control. Quality control (QC) samples were analyzed throughout each proximate analysis to ensure the validity of the data. Validation was performed at Texas A&M University by using beef and chicken baby food standards. These QC

standards were run with each batch during the analysis to ensure that the generated values fell within the acceptable range established by the FALCC. Any batch that contained a QC with values more than three standard deviations away from the set values were re-analyzed with an additional QC. In addition to QC samples, a blind duplicate was run with each batch during the analysis. A blind duplicate was selected at random from the samples analyzed in the run the day prior. If the CV of the blind duplicate, when compared to the original sample, was greater than 5%, the data were considered invalid and samples were re-analyzed. Also, if the CV of the individual samples (run in triplicate) was greater than 5%, the sample was considered invalid and the sample was re-analyzed.

3.8. Statistical analysis

Percentage values were calculated using data analysis functions in Microsoft Excel (Microsoft Corporation, Redmond, WA). Means, standard deviations, and mean separation by quality grade for each retail cut were calculated using the analyze function in JMP (SAS Institute, Cary, NC).

4. RESULTS AND DISSCUSSION

4.1. Cooking yields of beef retail cuts

Cooking yields of beef retail cuts are shown in Table 5. The results indicate very little difference between the cuts that were grilled. Percent cooking yield remained relatively constant for all five of the grilled cuts. Porterhouse and T-bone steaks had the highest cooked yields followed by both trim levels of top loin steaks. Jones et al. (1992a,b,c) determined that removing external fat decreased the values for cooking yield. These findings were similar to results in this study as cuts with external fat had higher cooking yields than those trimmed completely free of external fat. Tenderloin steaks and roasts exhibited the lowest cooked yields. The results also indicate that bone-in cuts had the highest overall cooking yield values.

4.2. Fat retention of the separable lean

Table 6 indicates the chemical fat retention values of the separable lean in cooked beef retail cuts. The results of this study follow suit with those of Jones et al. (1992a,b,c) and Coleman et al. (1988). These studies concluded that cuts containing a larger amount of external fat had higher fat retention values and higher fat content then those with lower amounts of external fat cover. The results in this study also concluded that cuts with external fat had higher fat retention values than the cuts trimmed completely free of external fat. As stated in Jones et al. (1992c), consumers should trim retail cuts prior to cooking in order to reduce fat intake.

4.3. Separable tissue components of raw and cooked retail cuts

Beef retail cuts evaluated in this study were dissected and separated into four different components: separable lean, seam fat, external fat, and refuse. The values for each of these components, per cut, are shown in Tables 7 and 8. These tables include means and standard deviations for each beef retail cut evaluated in this study. The results indicate that both raw and cooked cuts trimmed to lower levels of external fat had the highest values for percent lean and the lowest values for percent seam and external fat. These results are expected as these cuts were trimmed free of external fat and therefore the percent of external fat would clearly decrease and, in turn, percent separable lean would inevitably increase. This trend was also evident when evaluating the yields for bone-in cuts when compared to boneless cuts. Porterhouse and T-bone steaks had the lowest values for percent lean and the highest values for percent refuse. These results are expected as a larger proportion of bone-in cuts is bone, which increased the percentage refuse and decreased the percentage lean accordingly.

4.4. Proximate analyses of the separable lean

Proximate analyses were conducted on the separable lean of several of the retail cuts used in this study. These cuts along with the mean and standard deviations for the percentages of total chemical fat, moisture, ash, and protein are listed in Tables 9 and 10. Porterhouse and T-bone steaks had the highest levels of total chemical fat in both raw and cooked categories. Also, round cuts evaluated in the study contained a lower

percentage of total chemical fat than loin cuts on a raw basis. Another trend evident in the study was a decrease in percent moisture as the percentage of total chemical fat increased. This trend was also evident in studies conducted by Jones et al. (1992b), Wahrmund-Wyle et al. (2000b), and Mason et al. (2009). As expected, cuts that were cooked contained a lower percentage of moisture than their raw counterparts and, in turn, percentage total chemical fat, ash, and protein increased respectively.

Least squares means of the total chemical fat of the separable lean stratified by USDA quality grade (USDA, 1997) are shown in Tables 11 and 12. It is evident in these tables that there is a clear separation between upper Choice, lower Choice, and Select cuts when comparing percentage of total chemical fat. Upper Choice cuts clearly contain the highest values for percentage total chemical fat, followed by lower Choice cuts, and Select cuts contain the lowest percentage of total chemical fat. These results indicate the need to continue to report total fat values of retail cuts on an individual USDA quality grade basis.

4.5. Comparisons between the National Nutrient Database, 2006 National Beef Market Basket Survey, and the current study

The main objective of this study was to improve and update the National Nutrient Database to include any shifts in composition of beef retail cuts being sold in the United States today as compared to those sold in the past. Tables 13 and 14 show comparisons conducted between the data resulting from this portion of the study, results from the Market Basket Survey conducted by Mason et al. (2009), and the total chemical fat

values currently available in the National Nutrient Database. Nutritional information on numerous cuts that were evaluated in this study are not currently available in the National Nutrient Database. Of the cuts that were available for comparison, results from the portion of this study, conducted by Texas A&M University, indicate an increase in percentage of total chemical fat from the existing information listed in the National Database. This increase in percentage total chemical fat was also evident when comparing results from the portion of this study, conducted by Texas A&M University, to the Market Basket Survey conducted by Mason et al. (2009). While there are no cooked cut values to compare between the studies, cuts that were evaluated on a raw basis in this portion of the study contained higher total chemical fat than those evaluated on a raw basis in the 2006 Market Basket Survey. These results indicate a change in the composition of beef retail cuts available to consumers. Also, the lack of retail cut information in the National Nutrient Database indicates a need to include these new values with the existing nutritional information available in the database.

5. CONCLUSIONS

Results from this portion of the study correspond with studies conducted in the past. Results indicated that cooked yields and fat retention values were higher for cuts that contained a greater amount of external fat. Dissection data indicated that cuts trimmed to lower levels of external fat had the highest values for percent lean and the lowest values for percent seam and external fat, and proximate analyses indicated a decrease in percent moisture as the percentage of total chemical fat increased. Also, round cuts evaluated in the study contained a lower percentage of total chemical fat than loin cuts on a raw basis. The results from this study and studies like the 2006 Market Basket Survey (Mason et al., 2009) reflect a change in the beef products being sold in the market today. These studies are conducted in order to improve and enhance the nutritional information currently available to consumers. Surveys and improvement studies are an integral part of understanding the tendencies of the beef market. It is crucial that these studies are conducted on a regular basis to reflect any changes in the composition of beef products as production practices and merchandizing methods change over time. The constant shift in consumer preferences and the dynamic nature of the market insist that the existing nutritional database be continuously updated to reflect changes in the industry.

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APPENDIX A

Table 1
Animal assignments

City	Animal number	Quality grade	Yield grade	Gender	Genetics
Green Bay	1	Upper Choice	2	Steer	Dairy
Green Bay	2	Upper Choice	3	Steer	Native
Green Bay	3	Lower Choice	2	Heifer	Native
Green Bay	4	Lower Choice	3	Steer	Dairy
Green Bay	5	Select	2	Steer	Native
Corpus Christi	19	Upper Choice	3	Steer	Native
Corpus Christi	21	Lower Choice	3	Steer	Native
Corpus Christi	22	Select	2	Heifer	Native
Tolleson	20	Lower Choice	2	Steer	Dairy
Tolleson	23	Select	3	Steer	Dairy

Table 2
Carcass data

City	Carcass weight (kg)	Ribeye area (cm^2)	Fat thickness (cm)	Yield grade	Marbling score	
Green Bay	398.3	84.5	0.5	2.8	Md^{60}	Md^{40}
Green Bay	400.1	81.3	0.4	2.5	Mt^{60}	Mt^{70}
Green Bay	368.3	92.3	1.3	3.3	Md^{50}	Md^{60}
Green Bay	378.7	91.0	1.6	3.7	Md^{60}	Md^{40}
Green Bay	313.9	80.6	1.0	2.7	Sm^{60}	Sm^{40}
Green Bay	299.4	73.5	0.5	2.4	Sm^{50}	Sm^{80}
Green Bay	390.3	77.4	0.7	3.4	Sm^{30}	Sm^{40}
Green Bay	393.5	72.9	0.4	3.2	Sm^{50}	Sm^{50}
Green Bay	356.1	79.4	0.5	2.5	Sl^{20}	Sl^{30}
Green Bay	370.6	95.5	0.6	2.2	Sl^{60}	Sl^{80}
Corpus Christi	367.6	92.9	1.9	3.6	Mt^{20}	Mt^{40}
Corpus Christi	388.7	86.5	1.4	3.8	Mt^{40}	Mt^{00}
Corpus Christi	351.8	99.4	1.6	3.2	Sm^{50}	Sm^{80}
Corpus Christi	371.9	93.5	1.2	3.0	Sm^{30}	Sm^{40}
Corpus Christi	325.0	83.9	0.9	2.6	Sl^{30}	Sl^{50}
Corpus Christi	308.9	78.7	1.1	2.9	Sl^{70}	Sl^{60}
Tolleson	367.4	83.9	0.7	2.5	Sm^{20}	Sm^{20}
Tolleson	336.1	78.1	0.7	2.8	Sm^{60}	Sm^{70}
Tolleson	376.9	89.7	1.2	3.0	Sl^{50}	Sl^{70}
Tolleson	340.2	77.4	1.1	3.1	Sl^{60}	Sl^{40}

Table 3
Cooking and trim level randomizations

Animal number	Raw	Cooked	Fat level randomization
1	Left	Right	0.3 cm
2	Right	Left	0.0 cm
3	Left	Right	0.0 cm
4	Right	Left	0.3 cm
5	Right	Left	0.3 cm
19	Left	Right	0.3 cm
20	Right	Left	0.0 cm
21	Right	Left	0.3 cm
22	Right	Left	0.3 cm
23	Left	Right	0.0 cm

Table 4
Retail cuts with cooking method

Retail cut	URMIS[a]	Cooking method
Porterhouse steak	1330	Grilled
T-bone steak	1369	Grilled
Top loin steak, boneless, 0.3 cm trim	1404	Grilled
Top loin steak, boneless, 0.0 cm trim	1404	Grilled
Tenderloin roast	1386	Roasted
Tenderloin steak	1388	Grilled

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).

Table 5
Retail cut cooked yields

Retail cut	URMIS[a]	n	Cooking method	Cooked yield (%)[b] Mean	SD
Porterhouse steak	1330	80	Grilled	89.71	2.66
T-bone steak	1369	50	Grilled	89.79	3.36
Top loin steak, boneless, 0.3 cm trim	1404	57	Grilled	87.44	2.67
Top loin steak, boneless, 0.0 cm trim	1404	57	Grilled	85.46	2.34
Tenderloin roast	1386	18	Roasted	80.65	1.55
Tenderloin steak	1388	30	Grilled	79.73	2.63

Data are means and SD (standard deviations) for indicated number of sample.
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Cooked yield = (cooked weight/raw weight) x 100.

Table 6
Chemical fat retention from cooked retail cuts

Retail cut	URMIS[a]	Fat retention (%)[b] Mean	SD
Porterhouse steak	1330	131.36	13.16
T-bone steak	1369	147.78	20.05
Top loin steak, boneless, 0.3 cm trim	1404	135.13	12.63
Tenderloin roast	1386	110.20	10.24

Data are means and SD (standard deviations) (n=10).
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Fat retention = (percentage total fat of cooked retail cut/percentage total fat of raw retail cut) x cooked yield percentage.

Table 7
Percentage separable components of raw retail cuts

			Lean (%)		Seam fat (%)		External fat (%)		Refuse (%)[b]	
Retail cut	URMIS[a]	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Porterhouse steak	1330	79	65.95	3.44	3.48	2.07	6.06	2.15	23.76	3.81
T-bone steak	1369	50	61.51	4.10	3.71	2.81	7.14	2.36	26.86	5.03
Top loin steak, boneless, 0.3 cm trim	1404	56	80.50	2.70	6.44	2.68	5.53	2.31	6.61	2.11
Top loin steak, boneless, 0.0 cm trim	1404	56	87.37	2.60	1.96	1.89	2.31	1.97	7.57	1.73
Tenderloin roast	1386	20	95.85	2.01	1.35	1.40	1.72	1.40	0.66	0.81
Tenderloin steak	1388	30	96.76	2.16	1.00	2.21	1.94	0.92	0.00	0.00
Eye of round steak	1481	60	98.48	0.54	0.00	0.00	0.98	0.43	0.03	0.17
Eye of round roast	1480	20	98.68	0.69	0.00	0.00	0.94	0.43	0.18	0.50
Top round steak	1553	40	97.75	0.77	0.10	0.24	1.29	0.57	0.25	0.40
Top round roast	1455	30	97.07	1.11	0.25	0.32	1.93	0.79	0.43	0.49

Data are means and SD (standard deviations) for indicated number of sample.
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Bone and connective tissue.

Table 8
Percentage separable components of cooked retail cuts

			Lean (%)		Seam fat (%)		External fat (%)		Refuse (%)[b]	
Retail cut	URMIS[a]	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Porterhouse steak	1330	80	62.37	4.17	3.50	2.17	5.94	1.65	27.88	4.34
T-bone steak	1369	50	58.21	4.37	2.82	2.30	7.68	2.78	30.98	4.53
Top loin steak, boneless, 0.3 cm trim	1404	57	81.48	2.75	5.35	2.72	5.52	1.91	7.36	1.49
Top loin steak, boneless, 0.0 cm trim	1404	57	89.17	1.81	1.37	0.92	1.90	1.44	7.37	1.72
Tenderloin roast	1386	20	97.97	1.30	1.30	1.08	0.42	0.29	0.19	0.34
Tenderloin steak	1388	30	98.05	2.15	0.75	1.60	1.11	1.21	0.05	0.29

Data are means and SD (standard deviations) for indicated number of sample.
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Bone and connective tissue.

Table 9
Percentage total chemical fat, moisture, ash, and protein (separable lean only) for raw retail cuts

		Total fat (%)		Moisture (%)		Ash (%)		Protein (%)	
Retail cut	URMIS[a]	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Porterhouse steak	1330	8.36	1.90	70.39	1.67	1.07	0.03	21.97	0.78
T-bone steak	1369	7.59	1.74	70.88	1.39	1.05	0.01	22.15	0.46
Top loin steak, boneless, 0.3 cm trim	1404	6.92	1.94	70.83	1.17	1.12	0.04	22.91	0.75
Tenderloin roast	1386	6.75	1.37	72.62	0.82	1.26	0.07	21.65	0.84
Eye of round roast	1480	3.62	0.88	73.88	0.53	1.18	0.04	23.59	0.24
Top round roast	1455	3.61	0.87	73.44	0.56	1.21	0.03	23.45	0.42

Data are means and SD (standard deviations) (n=10).
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).

Table 10
Percentage total chemical fat, moisture, ash, and protein (separable lean only) for cooked retail cuts

		Total fat (%)		Moisture (%)		Ash (%)		Protein (%)	
Retail cut	URMIS[a]	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Porterhouse steak	1330	12.12	2.43	61.95	1.37	1.10	0.04	26.27	1.52
T-bone steak	1369	12.21	1.82	61.91	1.59	1.09	0.05	26.71	1.22
Top loin steak, boneless, 0.3 cm trim	1404	10.59	2.51	62.39	1.77	1.16	0.06	28.16	1.06
Top loin steak, boneless, 0.0 cm trim	1404	9.89	2.74	61.88	1.85	1.16	0.04	28.91	1.14
Tenderloin roast	1386	9.15	1.62	64.86	1.19	1.42	0.13	26.77	0.78
Tenderloin steak	1388	10.96	2.15	60.55	1.46	1.55	0.17	29.36	1.53

Data are means and SD (standard deviations) (n=10).
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).

Table 11
Least squares means of total chemical fat percentage of separable lean for raw retail cuts, stratified by USDA quality grade

		Upper Choice		Lower Choice		Select	
Retail cut	URMIS[a]	Total fat (%)	SEM[b]	Total fat (%)	SEM[b]	Total fat (%)	SEM[b]
Porterhouse steak	1330	10.11a	0.70	8.60ab	0.75	6.28b	0.21
T-bone steak	1369	9.58a	0.77	7.32b	0.49	5.95b	0.28
Top loin steak, boneless, 0.3 cm trim	1404	8.76a	1.47	6.37a	0.67	5.82a	0.31
Tenderloin roast	1386	7.30a	0.93	6.82a	0.51	6.10a	1.03
Eye of round roast	1480	4.15a	0.12	3.47ab	0.68	3.31b	0.15
Top round roast	1455	4.21a	0.42	3.42a	0.48	3.26a	0.49

Data are means and SEM (n=10).
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Standard error of the least squares means.
Means within the same row lacking a common letter (a-b) differ ($P < 0.05$).

Table 12
Least squares means of total chemical fat percentage of separable lean for cooked retail cuts, stratified by USDA quality grade

		Upper Choice		Lower Choice		Select	
Retail cut	URMIS[a]	Total fat (%)	SEM[b]	Total fat (%)	SEM[b]	Total fat (%)	SEM[b]
Porterhouse steak	1330	14.79a	0.83	11.99ab	0.86	9.63b	0.14
T-bone steak	1369	13.46a	0.50	12.54ab	1.09	10.53b	0.33
Top loin steak, boneless, 0.3 cm trim	1404	12.92a	1.42	10.04a	1.01	8.99a	1.10
Top loin steak, boneless, 0.0 cm trim	1404	12.24a	1.72	9.77a	1.02	7.69a	0.99
Tenderloin roast	1386	10.24a	0.96	9.26a	0.38	7.91a	1.17
Tenderloin steak	1388	12.19a	1.20	11.54a	0.59	8.97a	1.35

Data are means and SEM (n=10).
[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Standard error of the least squares means.
Means within the same row lacking a common letter (a-b) differ ($P < 0.05$).

Table 13
Comparison of USDA National Nutrient Database with information from the 2006 National Beef Market Basket Survey and the current study for total chemical fat in raw retail cuts

		TAMU data, 2011	Market Basket	National Database	Difference (%)[b]	
		Total chemical fat (%)	Total chemical fat (%)	Total chemical fat (%)	Market	National
Retail cut	URMIS[a]	Mean	Mean	Mean	Basket	Database
Porterhouse steak	1330	8.36	6.99		19.60	
T-bone steak	1369	7.59	6.27		21.05	
Top loin steak, boneless, 0.3 cm trim	1404	6.92	5.49	5.15	26.05	34.37
Tenderloin roast	1386	6.75				
Eye of round roast	1480	3.62	3.30		9.70	
Top round roast	1455	3.61	2.04		76.96	

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Difference, % = [(TAMU data, 2011 – Market Basket) / Market Basket] x 100; % = [(TAMU data, 2011 – National Database) / National Database] x 100

Table 14
Comparison of USDA National Nutrient Database with the current study for total chemical fat in cooked retail cuts

		TAMU data, 2011	National Database	
		Total chemical fat (%)	Total chemical fat (%)	
Retail cut	URMIS[a]	Mean	Mean	Difference (%)[b]
Porterhouse steak	1330	12.12		
T-bone steak	1369	12.21		
Top loin steak, boneless, 0.3 cm trim	1404	10.59	7.09	49.37
Top loin steak, boneless, 0.0 cm trim	1404	9.89	6.37	55.26
Tenderloin roast	1386	9.15		
Tenderloin steak	1388	10.96	7.86	39.44

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b]Difference, % = [(TAMU data, 2011 – National Database) / National Database] x 100

APPENDIX B

Beef Nutrient Database Improvement Study
SOP 1.3

PACKING PLANT COLLECTION PROTOCOL

1.Purpose:

1.1. To describe the procedure for identifying carcasses and collecting cuts for the Beef Nutrient Database Improvement Study.

2.Materials

2.1. Identification tags, multiple per carcass (See sample tag A), and tagging guns
2.2. Data Collection Sheets
2.3. Clipboards, Pens, Markers
2.4. Fat Depth Probe
2.5. Marbling Cards
2.6. Ribeye Dot Grid
2.7. Refrigerated Truck
2.8. Cooler (0-4°C)

3.Sampling Plan

i. Plant – Animal Assignments

Each animal number represents a set quality grade, yield grade, gender and genetic combination that has been determined in order to represent at least 85% of the beef carcasses in the U.S. if any selection criteria needs to be altered for a specific animal due to limiting factors at a plant location, the study statistician must be contacted immediately to assure that the sampling plan can maintain balance and strength. NOTE: plant-animal assignments can be found on page 5 (Table 1).

ii.University Plant Assignments

Specific plant location may be changed by the university if the original plant selected it difficult to work with or does not have the appropriate cattle necessary to fill the sampling matrix. If it is necessary to select product from a different plant than those that are specified the study statistician must be notified.

1. Colorado State University
    - Greeley
    - Kansas (Dodge City)

2. Texas A&M University
    - Green Bay
    - Tolleson
    - Corpus Christi
3. Texas Tech University
    - Plainview
    - Nebraska (Omaha)

iii. Larry Douglass (study statistician) should be informed by each university of plant collection dates conducting in order to be on call for possible changes in the sampling plan.

4.Procedure

i. Guidelines for carcass selection

NOTE#1: Two carcasses (A & B) will be selected for all loin cuts and one carcass side will be selected for all round cuts

NOTE#2: Cuts to be procured as follows:

- Short loins-IMPS #174 (Carcass A)
- Strip loins-IMPS #180 (Carcass B)
- Full Tenderloins, defatted-IMPS # 189A (Carcass B)
- Top rounds (cap-on)-IMPS #168 (Carcass A or B)
- Eye of round-IMPS #171C (Carcass A or B)

NOTE#3: Please use these IMPS and make sure that tails are not trimmed shorter than ½" on all loin cuts (to assure that product will be uniform prior to fabrication).

ii. All standard carcass data will be collected on the respective NDI Data Form

iii. Following the data collection all data shall be entered into the official tracking spreadsheet.

1. Proper quality control measures in reviewing the data must occur prior to submitting the data to the study tracker
2. Data entry **must be consistent** (ie: case sensitive, cut names, etc…) within and across all data files

iv. Data Point to be Collected (See Table 2 for List of data Points)

1. USDA Graders will categorize carcasses into the official grade categories (Ch, Se, YG2, YG3)
2. University personnel will make specific quality and yield grade measurements using guided instrumentation
    - If university grade assessments disagree with USDA graders then the carcass shall not be selected into the study.
    - Call and record marbling on **both** sides (left and right sides) of the carcass

i. Marbling scores shall not cross the grade line
    1. Example: if the right side of a carcass has Slight 90 marbling and its left side has Small 10 marbling then this carcass can not be selected into the study.

ii. Aim to select representative marbling scores within marbling categories
    1. Categories of Choice marbling by % of Choice in market
        a. 8.8% Moderate
        b. 26.9% Modest
        c. 64.2% Small
    2. Categories of Select marbling by % Select in market
        a. 40% Slight +
        b. 60% Slight –

- Numeric Scales to be used in the data entry spreadsheet so that the data is ready for analysis

i. Marbling Scale: Marbling score should be assessed to the <u>nearest 10</u>.
    - Slight 0 - 99= 300 - 399
    - Small 0 - 99= 400 - 499
    - Modest 0 - 99= 500 - 599
    - Moderate 0-99 = 600 – 699

ii. Skeletal / Lean Maturity Scale: Assess to the nearest 10
    a. A 0 – A 90= 0 – 90

iii. Overall Quality Grade Scale:
    a. Low Select = 1
    b. High Select = 2
    c. Low Choice = 3
    d. Ave. Choice = 4
    e. High Choice= 5

iv. Percentage KPH: enter actual percentage, not the adjustment factor
    a. 3.5% = 0 adjustment. >3.5%= positive adjustment; <3.5 = negative adjustment

4.5 = +.2
4.0 = +.1
3.5 = 0
3.0 = -.1
2.5 = -.2
3.0 = -.3
2.5 = -.4
2.0 = -.5
1.5 = -.6
1.0 = -.7
0.5 = -.8

2. Duplicate carcasses (A & B) shall be selected to be as close in marbling scores as possible (not to cross the grade line). All other characteristics should fall into the outlined criteria.
    a. It is acceptable for duplicate Upper Choice carcasses cross the Modest/Moderate marbling score line
3. University personnel will be responsible for identifying dairy carcasses

v. All animals selected shall be A maturity only

vi. Carcass weights should fit the following weight ranges:
    1. 700 – 950 lb. for steers and dairy carcasses
    2. 650 – 900 lb. for heifer carcasses

vii. Carcasses selected for this study shall have hump heights less than 4" measured from the thoracic vertebrae

viii. Carcasses selected for this study shall be free of major defects
    1. Bruises, dark cutting, blood splash, callous ribeyes, yellow fat, miss split, etc…

Identification of cuts

ix. All cuts will be labeled with proper identification tags
    1. Refer to Sample Tag – A

PACKING PLANT TAG ID'S

1. Project # (28150-P3)
2. Date of Carcass Collection
3. University (AM, CS, TT)
4. Carcass A or B
5. Animal ID # (1-36)
6. Side of Carcass (R/L)
7. Cooked or Raw

SAMPLE TAG - A

28150-P3 1/20/10

AM-B-10-R

Cooked

Transportation of cuts from packing plant to the University

x. Each university will make arrangements for proper transportation of selected cuts to their respective meat lab.
xi. Product must be transported in refrigerated temperature.
xii. Using the official study sample receiving form, record the temperature of two cuts (from two different boxes) when received at the university.
   a. Re-vacuum package the cuts in which the packaging was disturbed to take temperatures.

Storage of cuts prior to fabrication

xiii. All cuts shall be stored in a cooler at (0°- 4° C)
xiv. Proper daily temperature logs shall be maintained by each university to verify their cooler maintained the proper temperature.
xv. Fabrication and freezing of retail cuts should occur between 14-21 days postmortem.

Tracking

xvi. NDI electronic Tracking Spreadsheet shall be completed and forwarded to the Project Tracking Manager (PTM) according to Tracking Protocol found in the Master Study Protocol.
xvii. Naming Files: University code.study #, packplant.packplantname(mm-dd).xls: TTU.28910-P2.packplant.Plainview(mm-dd-yy).xls.

TABLE 1. Plant-Animal Assignment

Univ	Plant	Animal #	QG	YG	Gender	Genetics	Raw	Start with	Composite
TAM	Greenbay	1	U	2	S	D	L	1/8"	1
TAM	Greenbay	2	U	3	S	N	R	0"	1
TAM	Greenbay	3	L	2	H	N	L	0"	3
TAM	Greenbay	4	L	3	S	D	R	1/8"	3
TAM	Greenbay	5	S	2	S	N	R	1/8"	5
CSU	Greeley	6	U	2	S	N	L	1/8"	1
CSU	Greeley	7	U	3	S	N	R	0"	1
CSU	Greeley	8	L	2	S	N	L	1/8"	3
CSU	Greeley	9	L	3	H	N	R	0"	3
CSU	Greeley	10	S	2	H	N	R	0"	5
CSU	Greeley	11	S	3	S	N	L	1/8"	5
CSU	Dodge City	12	U	2	H	N	L	0"	1
CSU	Dodge City	13	U	3	H	N	R	1/8"	1
CSU	Dodge City	14	L	2	S	N	R	0"	3
CSU	Dodge City	15	L	3	S	N	L	1/8"	3
CSU	Dodge City	16	S	2	S	N	L	0"	5
CSU	Dodge City	17	S	3	H	N	R	0"	5
CSU	Dodge City	18	S	3	S	N	L	1/8"	5
TAM	Corpus Christi	19	U	3	S	N	L	1/8"	2
TAM	Tolleson	20	L	2	S	D	R	0"	4
TAM	Corpus Christi	21	L	3	S	N	R	1/8"	4
TAM	Corpus Christi	22	S	2	H	N	R	1/8"	6
TAM	Tolleson	23	S	3	S	D	L	0"	6
TTU	Plainview	24	U	3	H	N	L	0"	2
TTU	Plainview	25	U	2	S	N	R	1/8"	2
TTU	Plainview	26	L	2	H	N	L	1/8"	4
TTU	Plainview	27	L	3	S	N	R	0"	4
TTU	Plainview	28	S	2	S	N	L	0"	6
TTU	Plainview	29	S	3	S	N	R	1/8"	6
TTU	Omaha	30	U	2	S	N	L	0"	2
TTU	Omaha	31	U	2	H	N	R	1/8"	2
TTU	Omaha	32	U	3	S	N	R	0"	2
TTU	Omaha	33	L	2	S	N	L	0"	4
TTU	Omaha	34	L	3	H	N	L	1/8"	4
TTU	Omaha	35	S	2	S	N	R	1/8"	6
TTU	Omaha	36	S	3	H	N	L	0"	6

Codes:
Animal 1-36
QG - U=Upper choice, L=Lower choice, S=Select
YG 2-3
Gender - S=Steer, H=Heifer
Genetics - N=Native, D=Dairy
Raw/Cooked - R=Right, L=Left
The first steak is either 0" trim or 1/8" trim
Compoiste1-6, for the six composite ID

TABLE 2. Packing Plant Data Points to Collect

Data Point	Description of Data Point
1	Study #
2	Plant # Name
3	University (AM, CS,TT)
4	Carcass Collection Date (mm/dd/yy)
5	Sequence #
6	Carcass Kill Date (mm/dd/yy)
7	Shipped from plant (mm/dd/yy)
8	Arrived at Univ (mm/dd/yy)
9	Animal ID (1-36; a/b)
10	Yield Grade (2/3)
11	QG (U/L/S)
12	Gender (S/H)
13	Genetics (N/D)
14	PYG
15	Adj. PYG
16	HCW (lbs)
17	REA
18	KPH %[1]
19	Actual YG (nearest 0.1)
20	Lean Maturity[2]
21	Skeletal Maturity[2]
22	Marbling Score (R) [3]
23	Marbling Score (L) [3]
24	Actual QG [4]

[1] Enter the percentage KPH not the adjustment factor

[2] A0 – A90 = 0 – 90

[3] Slight 0 - 90 = 300 - 390, Small 0 - 90 = 400 - 490, Modest 0 - 90 = 500 - 590, Moderate 0-90 = 600 – 690

[4] Low Select = 1; High Select = 2; Low Choice = 3; Ave. Choice = 4; High Choice = 5

Beef Nutrient Database Improvement Study
SOP 2.3A

LOIN FABRICATION PROTOCOL

1. Purpose:

1.1. To describe the procedure for fabricating beef loins for the retail cuts needed for this study.
Product will be vacuum-packaged and stored without exposure to light at 0-4°C. Fabrication to retail portions shall occur between 14-21 days. Retail cuts shall be properly identified, packaged and placed in frozen storage (-18°C) on the day of fabrication.

2. Materials

2.1. Carcass cooler (0°- 4°C)
2.2. Daily Temperature Recorder/Logger
2.3. Cryovac Machine and bags
2.4. Post fabrication cuts to be frozen and stored below -18°C

3. Fabrication to retail cut weights

3.1. Scale considerations
3.1.1. All scales should be calibrated each day
3.1.2. Scale should be on level surface.
3.1.3. **Take weight to the nearest 0.1 g for retail cut weights**
3.1.4. Zero before each weight
3.1.5. Wipe residue from weigh pan after each weight

3.2. Net weights to be recorded on the Fab to Retail Cut spread sheet (See Table 1.)

Retail Cut	**Cooked/ Raw**
• Beef, Loin, Porterhouse Steak 1/8”	Cooked/Raw
• Beef, Loin, T-Bone Steak 1/8”	Cooked/Raw
• Beef, Loin, Top Loin Steak, Bnls 1/8”	Cooked/Raw
• Beef, Loin, Top Loin Steak, Bnls 0”	Cooked/Raw
• Beef, Loin, Tenderloin Steak 0”	Cooked/Raw
• Beef, Loin, Tenderloin Roast 0”	Cooked/Raw

4. Data Collection

4.1. All standard carcass data will be collected on the respective NDI Data Form (See SOP 12.3 Data Management).

4.2. Within two weeks of data collection, the respective data shall be entered into the official standardized tracking spreadsheet.

4.2.1. Proper quality control measures in reviewing the data must occur prior to submitting the data to the study tracker.

4.2.2. Data entry **must be consistent** (i.e.: case sensitive, cut names, etc…) within and across all data files.

4.3. Data point to be collected.

5. Fabrication Procedure

5.1. Carcass A = Porterhouse Steaks and T-Bone Steaks

Refer to Table 2 Plant Animal Assignment and Compositing for Loin Randomization by section.

5.1.1. Short loins will be procured to obtain Porterhouse and T-Bone steaks.

5.1.2. The tail on the short loins will be trimmed to 1".

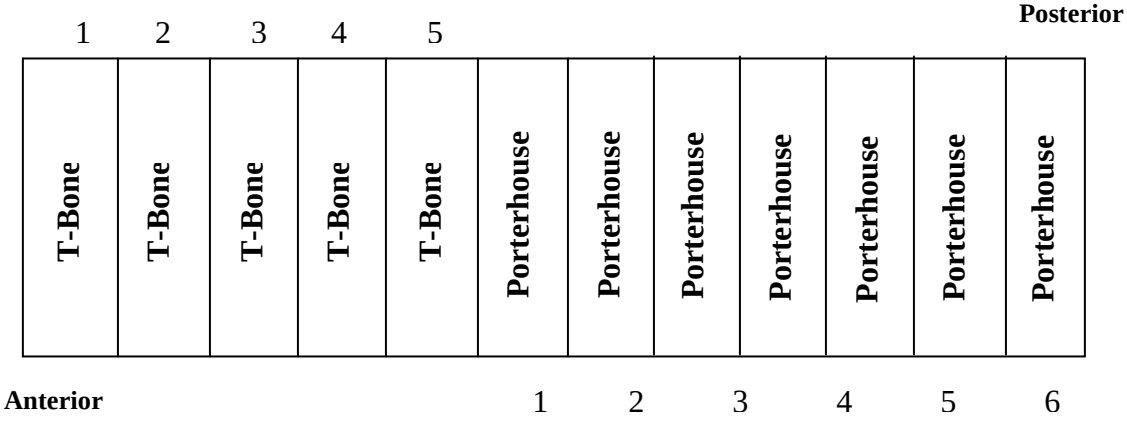
5.1.3. Face the posterior end of the loin prior to cutting steaks. Porterhouse and T-Bone steaks will be cut posterior to anterior and will be 1" in thickness.

5.1.4. External fat on Porterhouse and T-Bone steaks will be trimmed to 1/8". On Porterhouse steaks, the fat may be notched under the tenderloin; although KPH may crumble, try not to denude the tenderloin. Tails may also require some degree of trimming but shall remain present on the steak. If present, the *Longissimus costarum* should remain on the steak and the external fat should be trimmed to 1/8".

5.1.5. A Porterhouse steak will have a minimum tenderloin width (measured perpendicular to the transverse process) of 1.25". A T-Bone steak will have a tenderloin thickness (measured as described previously) of 0.5" to 1.25". Any steaks with a tenderloin width less than 0.5" will not be used for this study.

5.1.6. Diagram for Porterhouse and T-Bone steak collection

NOTE: Below is an example of a short loin that yields five T-Bone and seven Porterhouse steaks. Not all short loins will yield the same number of steaks (most short loins will yield twelve steaks). Please refer to the criteria listed above to identify T-Bone and Porterhouse steaks. **Steaks are to be numbered from the anterior end to the posterior end, starting at 1 and counting upwards for each steak.**



5.2.Carcass B = Tenderloin Steaks, Tenderloin Roasts, and Top Loin Steaks Bnls (0" & 1/8")

Refer to Table 2 Plant Animal Assignment and Compositing for Loin Randomization by section.

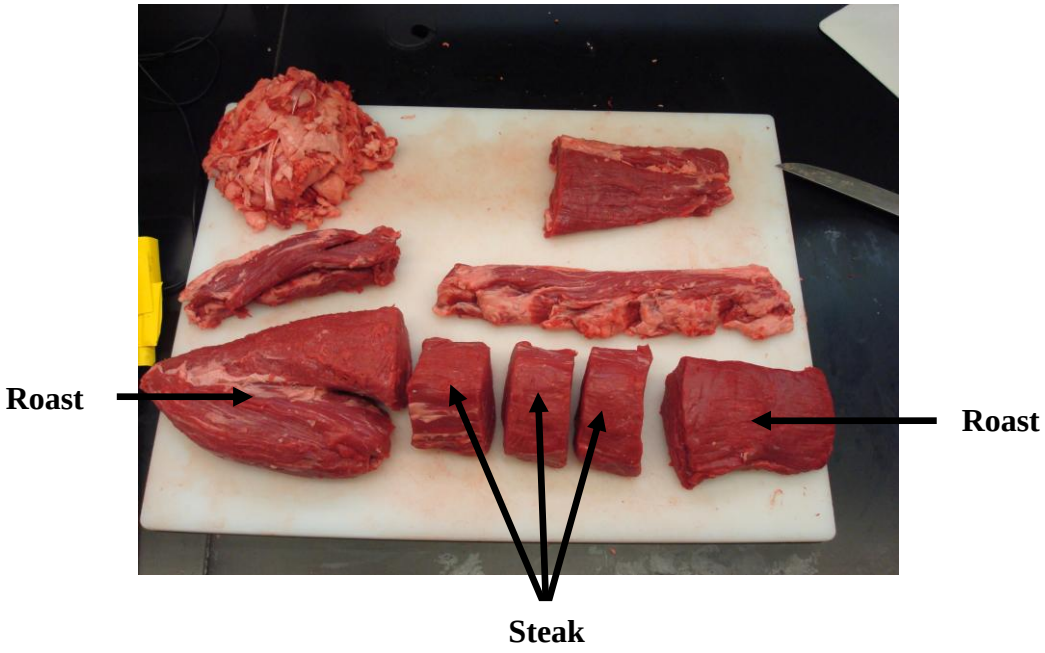
5.2.1. The full tenderloin will be procured from the carcass, external fat will be trimmed to 0” and silver skin will be removed.

5.2.2. The tail of the tenderloin will be removed at 1” in diameter.

5.2.3. Side muscle will be removed from the tenderloin.

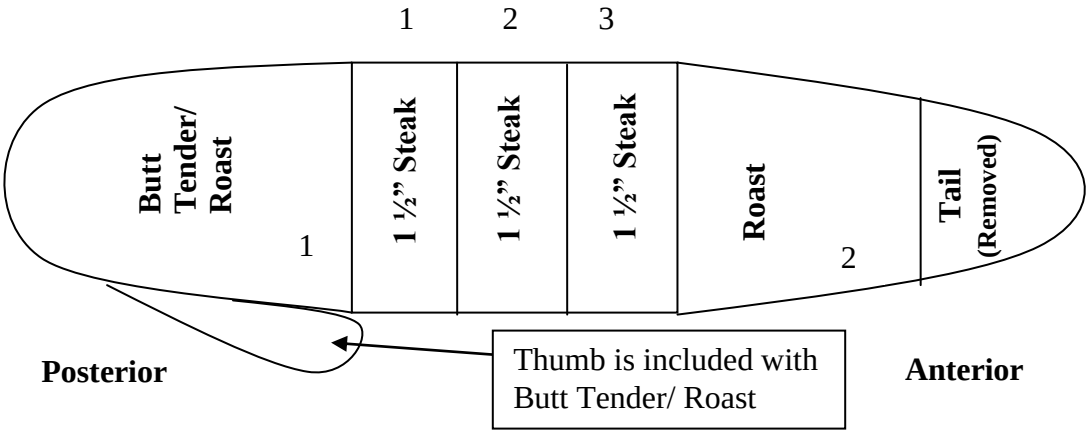
5.2.4. Three center cut steaks 1 ½" in thickness will be removed from the center of the tenderloin.

5.2.5. The remaining butt and tail sections from the tenderloin will be the tenderloin roasts.



5.2.6. Diagram for Tenderloin roast and steak collection

NOTE: Steaks and Roasts will be numbered. Butt tender/roast will be roast number 1 and the middle roast will be roast number 2. Steaks are to be numbered 1 through 3 from the posterior end to the anterior end.



5.2.7. A full boneless strip loin will be procured from the plant to obtain top loin steaks

5.2.8. Face the anterior end of the strip loin. Top loin steaks 1" in thickness will be cut anterior to posterior.

5.2.9. Steaks will alternate between 0" to 1/8" external fat trim levels. The trim level for the first steak of each loin will be provided to us by Larry to ensure proper alternation and randomization of trim levels across strip loins.

5.2.10. Steaks with 0” trim will not have a tail. Steaks will 1/8” trim will have a ½” tail. Vein steaks must be identified and are defined as those steaks with *Gluteus medius* present on both sides of the steak.

5.2.11. Diagram for Top Loin steak collection (TRUE SEQUENCE PROVIDED BY LARRY- Table 2)

NOTE: Below is an example of a strip loin that yields twelve steaks. Not all strip loins will yield the same number of steaks. **Steaks are to be numbered from the anterior end to the posterior end, starting at 1 and counting upwards for each steak.**

Anterior **Posterior**

0”	1/8”	0”	1/8”	0”	1/8”	0”	1/8”	0”	1/8”	0”	1/8”
1	2	3	4	5	6	7	8	9	10	11	12

OR

1/8”	0”	1/8”	0”	1/8”	0”	1/8”	0”	1/8”	0”	1/8”	0”

Anterior **Posterior**

6. Storage and Identification

6.1 Following the fabrication all cuts should be tagged and vacuum packaged, with no administration of heat shrinking, Cuts should be frozen on the same day as fabrication by placing them in a single layer in frozen storage (below -18°C). Transmission properties of the bags used shall be recorded. Proper daily temperature logs shall be maintained by each university to verify that proper cooler and freezer temperature is maintained during all phases of storage.

ID TAGS FOR RETAIL CUTS

1. Project # (28150-P3)
2. Date of carcass collection
3. University (AM, CS, TT)
4. Carcass A or B
5. Animal # (1-36)
6. Side of carcass (R/L)
7. Steak Identification
8. Retail Cut name
9. Cooked/ Raw
10. If cooked, cooking method (grilled or roasted)

SAMPLE TAG - A **SAMPLE TAG - B**

28150-P3	**1/14/11**
AM-B-10-R	
Porterhouse Steak	
Cooked-Grill	

Table 1.

Beef Loin cuts to be collected, dissected and analyzed for NDI Phase 3

ID Code	Cut	Trim Level	URMIS	IMPS	Dissection		Individual Proximates		Nutrient Analysis[1]		Cook Method
					Raw	Cooked	Raw	Cooked	Raw	Cooked	
30BLPHS	Beef,Sht Loin, Prtrhs Steak	1/8	1330/2145	1173	Yes	Yes	Yes	Yes	CP	CP	Grilled
31BLTBS	Beef, Sht Loin, T-Bone Steak	1/8	1369/2184	1174	Yes	Yes	Yes	Yes	CP	CP	Grilled
32BLTLSB-1/8	Beef, Loin, Top Loin Steak, Boneless	1/8	1404/	1180	Yes	Yes	Yes	Yes	CP+	CP+	Grilled
33BLTLSB-0	Beef, Loin, Top Loin Steak, Boneless	0	1404/	1180	Yes	Yes	No	Yes	No	Prox	Grilled
34BLTR	Beef, Loin,Tenderloin Roast	0	1386/	190A	Yes	Yes	Yes	Yes	CP	CP	Roasted
35BLTS	Beef, Loin, Tenderloin Steak	0	1395/	1190A	Yes	Yes	No	Yes	No	Prox, FA &Chol	Grilled

[1] If it indicates no raw data is needed but that the dissection data is needed we will still need the raw product for dissection weights. Prox = proximates, FA = fatty acid profile and Chol = Total Cholesterol; CP = Complete Nutrient Profile (Prox, FA's, CLA, Chol, ICP Minerals, Selenium, B-Vits (A Group); CP+ = CP plus B-Vits (B Group), Choline, Vit E, Vit D (raw & cooked); Prox = Only Proximate Data Required, No = No nutrient analysis required; NA = Non Applicable

Table 2.

Univ	Plant	Animal #	QG	YG	Gender	Genetics	Raw	Start with	Composite
TAM	Greenbay	1	U	2	S	D	L	1/8"	1
TAM	Greenbay	2	U	3	S	N	R	0"	1
TAM	Greenbay	3	L	2	H	N	L	0"	3
TAM	Greenbay	4	L	3	S	D	R	1/8"	3
TAM	Greenbay	5	S	2	S	N	R	1/8"	5
CSU	Greeley	6	U	2	S	N	L	1/8"	1
CSU	Greeley	7	U	3	S	N	R	0"	1
CSU	Greeley	8	L	2	S	N	L	1/8"	3
CSU	Greeley	9	L	3	H	N	R	0"	3
CSU	Greeley	10	S	2	H	N	R	0"	5
CSU	Greeley	11	S	3	S	N	L	1/8"	5
CSU	Dodge City	12	U	2	H	N	L	0"	1
CSU	Dodge City	13	U	3	H	N	R	1/8"	1
CSU	Dodge City	14	L	2	S	N	R	0"	3
CSU	Dodge City	15	L	3	S	N	L	1/8"	3
CSU	Dodge City	16	S	2	S	N	L	0"	5
CSU	Dodge City	17	S	3	H	N	R	0"	5
CSU	Dodge City	18	S	3	S	N	L	1/8"	5
TAM	Corpus Christi	19	U	3	S	N	L	1/8"	2
TAM	Tolleson	20	L	2	S	D	R	0"	4
TAM	Corpus Christi	21	L	3	S	N	R	1/8"	4
TAM	Corpus Christi	22	S	2	H	N	R	1/8"	6
TAM	Tolleson	23	S	3	S	D	L	0"	6
TTU	Plainview	24	U	3	H	N	L	0"	2
TTU	Plainview	25	U	2	S	N	R	1/8"	2
TTU	Plainview	26	L	2	H	N	L	1/8"	4
TTU	Plainview	27	L	3	S	N	R	0"	4
TTU	Plainview	28	S	2	S	N	L	0"	6
TTU	Plainview	29	S	3	S	N	R	1/8"	6
TTU	Omaha	30	U	2	S	N	L	0"	2
TTU	Omaha	31	U	2	H	N	R	1/8"	2
TTU	Omaha	32	U	3	S	N	R	0"	2
TTU	Omaha	33	L	2	S	N	L	0"	4
TTU	Omaha	34	L	3	H	N	L	1/8"	4
TTU	Omaha	35	S	2	S	N	R	1/8"	6
TTU	Omaha	36	S	3	H	N	L	0"	6

Codes:
Animal 1-36
QG - U=Upper choice, L=Lower choice, S=Select
YG 2-3
Gender - S=Steer, H=Heifer
Genetics - N=Native, D=Dairy
Raw/Cooked - R=Right, L=Left
The first steak is either 0" trim or 1/8" trim
Compoiste1-6, for the six composite ID

Beef Nutrient Database Improvement Study
SOP 2.3B

ROUND FABRICATION PROTOCOL

1. Purpose:

1.1. To describe the procedure for fabricating beef rounds for the retail cuts needed for this study. Product will be vacuum-packaged and stored without exposure to light at 0-4°C. Fabrication to retail portions shall occur between 14-21 days. Retail cuts shall be properly identified, packaged and placed in frozen storage (-18°C) on the day of fabrication.

2. Materials

2.1. Carcass cooler (0°-4°C)
2.2. Daily Temperature Recorder/Logger
2.3. Cryovac Machine and bags
2.4. Post fabrication cuts to be frozen and stored below -18°C

3. Fabrication to retail cut weights

3.1. Scale considerations
- **3.1.1.** All scales should be calibrated each day
- **3.1.2.** Scale should be on level surface.
- **3.1.3.** **Take weight to the nearest 0.1 g for retail cut weights**
- **3.1.4.** Zero before each weight
- **3.1.5.** Wipe residue from weigh pan after each weight

3.2. Net weights to be recorded on the Fab to Retail Cut spread sheet (see Table 1).

Retail Cut	**Cooked/ Raw**
• Beef, Round, Eye of Round Steak 0”	Raw
• Beef, Round, Eye of Round Roast 0”	Raw
• Beef, Round, Top Round Steak 0”	Raw
• Beef, Round, Top Round Roast 0”	Raw

4. Data Collection

4.1. All standard carcass data will be collected on the respective NDI Data Form (See SOP 12.3 Data Management).

4.2. Within two weeks of data collection, the respective data shall be entered into the official standardized tracking spreadsheet.

4.2.1. Proper quality control measures in reviewing the data must occur prior to submitting the data to the study tracker.

4.2.2. Data entry **must be consistent** (i.e.: case sensitive, cut names, etc…) within and across all data files.

4.3. Data point to be collected.

5. Fabrication Procedure

5.1.Eye of Round Steaks and Roasts

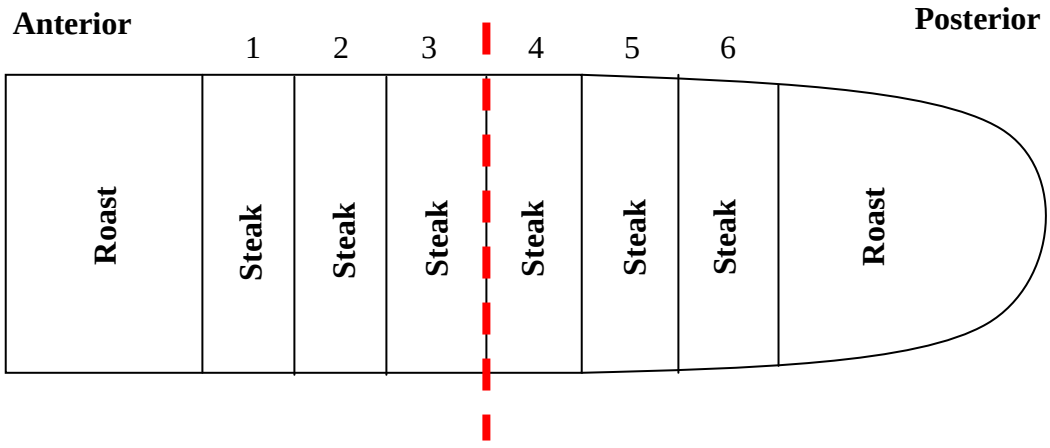
5.1.1. The eye of round will be removed whole from the carcass.

5.1.2. External fat will be trimmed to 0" and the silver skin on the anterior end of the subprimal will be removed.

5.1.3. Cut the subprimal in half.
5.1.4. Starting at the cut surface of each half, cut three 0.5" steaks.
5.1.5. The two remaining ends from the eye of round will be the eye of round roasts.

5.1.6. Diagram for Eye of Round roast and steak collection

NOTE: Steaks and Roasts will be numbered. The anterior roast will be number 1 and the posterior roast will be number 2. Steaks are to be numbered 1 through 6 from the anterior end to the posterior end.



5.2. Top Round Steaks and Roasts

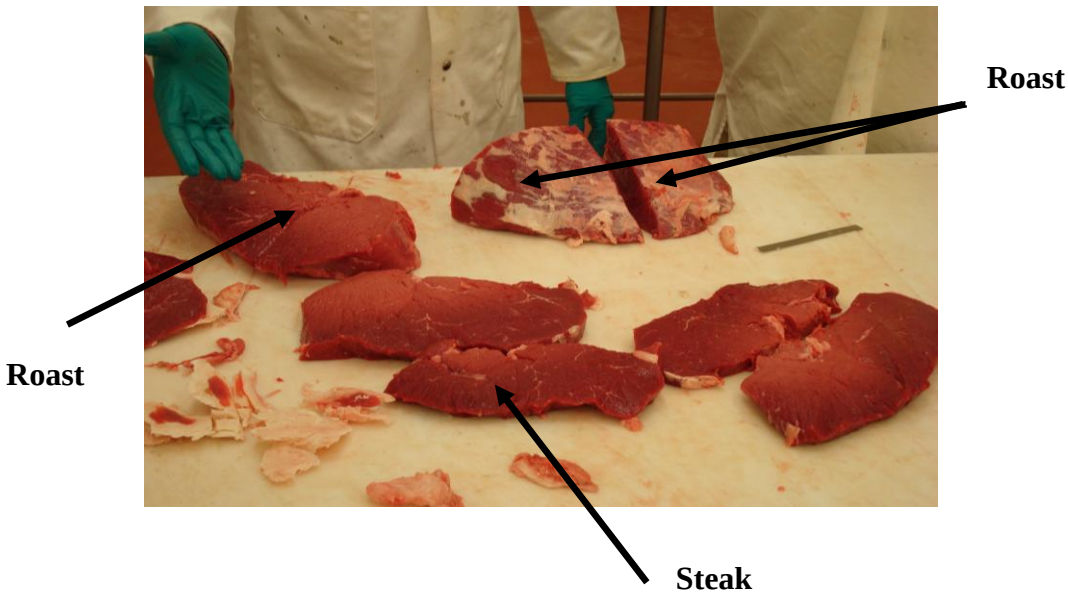
5.2.1. Whole top rounds (cap-on) will be obtained from the carcass.

5.2.2. Cap and "soft side" will be removed from the top round.

5.2.3. Top round external fat will be trimmed to 0".

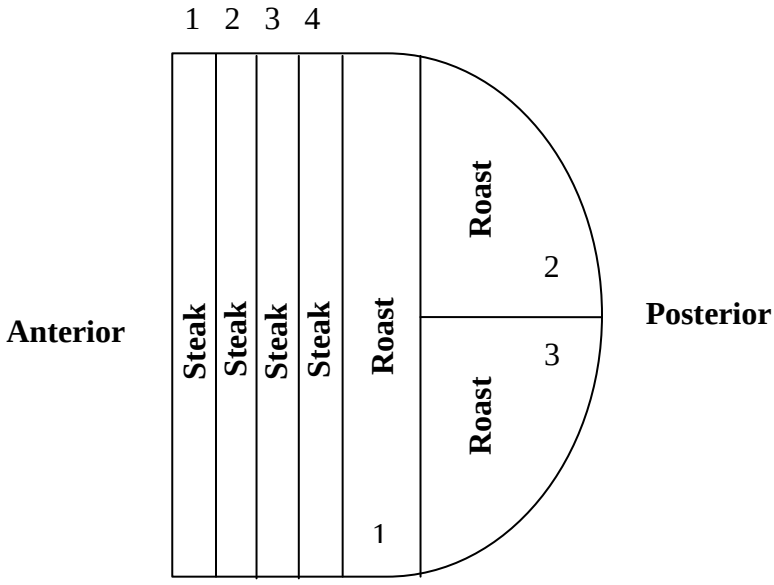
5.2.4. Face the anterior (aitch bone) surface prior to steak cutting.
5.2.5. Four top round steaks 0.75" in thickness will be removed starting from the anterior side of the top round.

5.2.6. One top round roast 2" in thickness will be cut in the manner as the top round steaks.
5.2.7. The remaining portion of the top round will be divided equally into two "wedge-shaped" roasts by making a cut perpendicular to the anterior face of the subprimal.



5.2.8. Diagram for Top Round roast and steak collection

NOTE: Steaks and Roasts will be numbered. The anterior roast will be number 1 and the posterior (wedge) roasts will be numbers 2 and 3. Steaks are to be numbered 1 through 4 from the anterior end to the posterior end.



6. Storage and Identification

6.1 Following the fabrication all cuts should be tagged and vacuum packaged, with no administration of heat shrinking, Cuts should be frozen on the same day as fabrication by placing them in a single layer in frozen storage (below -18°C). Transmission properties of the bags used shall be recorded. Proper daily temperature logs shall be maintained by each university to verify that proper cooler and freezer temperature is maintained during all phases of storage.

ID TAGS FOR RETAIL CUTS

1.Project # (28150-P3)
2.Date of carcass collection
3.University (AM, CS, TT)
4.Carcass
5.Animal # (1-36)
6.Side of carcass (R/L)
7.Steak Identification
8.Retail Cut name
9.Raw

SAMPLE TAG - A

28150-P3	**1/14/11**
AM-A-10-R **Top Round Steak** **Raw**	

Beef Nutrient Database Improvement Study
SOP 3.3

GRILLING PROTOCOL – DIRECT COOKING

1.Purpose

1.1. To describe the procedure for preparing and grilling beef retail cuts from the **Beef Loin and Round cuts**

Note: This protocol will be tested by the NDI Research Team on 12/13/10 at Texas Tech University, in Lubbock, TX.

2. Safety

2.1. Be careful when handling hot surfaces.

3.Materials

3.1. Electric grill - Salton two-sided electric with removable grill plates, Grill Model No. GRP99, Salton, Inc., Lake Forest, IL

3.2. Thermometers/thermocouples

3.2.1. Type J or K Thermocouple – Calibrate prior to use

3.2.2. Type J or K insulated wire

3.2.2.1. The thermocouple type and wire type must be the same (ie: if Type J wire is used the appropriate Type J Thermocouple Thermometer must be used)

3.2.3. Infrared Thermometer – Grill surface heat detection

3.3. Digital Scale

3.3.1. Calibrate daily

3.3.2. Record to the nearest 0.1 g

3.4. Beef Samples (Frozen, -20°C)

3.4.1. Beef Loin Porterhouse Steak (U.P.C. 1330/2145)

3.4.2. Beef Loin T-Bone Steak (U.P.C. 1369/2184)

3.4.3. Beef Loin Bnls Top Loin Steak, 1/8" trim (U.P.C. 1404)

3.4.4. Beef Loin Bnls Top Loin Steak, 0" trim (U.P.C. 1404)

3.5. Stainless steel tongs

3.6. Data Entry Form for Grilling

3.6.1.1.*Data4-Cooking.NDI.P3*

3.6.2. Table 1 outlines the specific data points to be collected on the Data 4 form.

3.7. Identification tags – Polyester Paper (Xerox Item No. 3R12363)

4.Beef Preparation before Cooking

4.1. Temper frozen raw samples in original package as a single layer in refrigeration (0-4°C) for 24-48 h based on the appropriate size and weight of the cut; record tempering start and stop date and time, cooler location and temperature of cooler.

4.2. Remove the product from its packaging and purge and blot with a paper towel.

4.3. Record initial internal temperature (*Internal Temp*) of each individual steak (should not exceed 5°C for thawed product).

4.4. Record raw weight of product to the nearest 0.1 g

4.4.1. All steaks segments for an individual sample number should be weighed individually.

4.5. For each steak, apply the thermocouple in the geometric center, or thickest portion of the meat piece.

4.5.1. Thermocouple positioning should not affect product's contact with the cooking surface.

5.Pre-heating

5.1. Turn on grill using manufacturer's instructions.

5.2. Close grill lid and allow grill to preheat for approximately 10 minutes (all grills must be calibrated and allowed to pre-heat based on each individual grill's warm-up time).

5.3. Allow grill temperature to equalize. Check and record surface temperature of the grill plates using the infrared thermometer – grill surfaces should be approximately 195°C before cooking begins.

5.4. Between cooking, wipe grill with a cloth to clean any excess cook loss off and wait for grill to re-heat back up to 195 °C.

6.Grilling

6.1. Make sure to cook the Beef Loin Bnls Top Loin Steak, 0" trim (U.P.C. 1404) and the Beef Loin Bnls Top Loin Steak, 1/8" trim (U.P.C. 1404) **SEPERATELY**, do not mix the cuts while cooking

6.2. Place the Beef Loin Porterhouse Steak (U.P.C. 1330/2145) and the Beef Loin T-Bone Steak (U.P.C. 1369/2184) **INDIVIDUALLY** on the grill for cooking (one per grill for cooking) with the bone perpendicular to the back of the grill.

6.3. Arrange beef sample(s) evenly spaced in center of cooking grate, with proper identification.

6.4. Cook with grill lid closed so that the grill plates are in contact with the meat.

6.4.1. If the grill grates are not in contact with the meat, reposition the steak so that contact can be made before proceeding.

6.5. Final Internal Temperatures

6.5.1. Cook each steak segment to an internal temperature of 70°C..

6.6. Remove from grill and immediately place on a wire rack at room temperature.

6.6.1. Use tongs or spatula to remove test samples from grill. Do not use fork.

6.7. Record the time (*Removal Time*) and final internal product temperature (*Final Temp*) when removed from heat.

6.8. Record cooked weight of product to the nearest 0.1 g at the time it is removed from the grill.

7.Allow beef samples(s) to chill **uncovered on a wire rack** under refrigeration (0-4° C) for 12-24 h before dissection.

7.1. Assure all ID tags are secure in order to maintain product identification

Table 1- Data Points to Record for Grilling

Data Point	Description of Data Point
1	Study # (28150-P3)
2	Univ (AM, CS,TT)
3	Animal(1-36; A/B/C)
4	Side (R/L)
5	ID Code[1]
6	Date Placed in Cooler (mm/dd/yy)
7	Time Placed in Cooler (Military Time)
8	Date of Cooking (mm/dd/yy)
9	Time of cooking (Military Time)
10	Raw Temp (Internal Temp of Individual Steaks prior to Cooking) (°C)
11	Raw Weight (Individual Retail Cut Weight- 0.1 g)[2]
12	Grill Surface Temp (°C)
13	Removal Time (time product removed from heat (Military Time))
14	Final Temp (Internal temperature of each Steak @ Removal Time(°C)
15	Cooked Weight (0.1 g) (Individual Cut weight @ Removal Time)

[1] See ID Code list

[2] Remove each steak from its package and its purge and blot with a paper towel

Beef Nutrient Database Improvement Study
SOP 5.3

ROASTING PROTOCOL

1. Purpose

1.1. To describe the procedure for preparing and roasting retail cuts from the **Beef Loin and Round cuts.**

Note: This protocol will be tested by the NDI Research Team on 12/13/10 at Texas Tech University, in Lubbock, TX.

Safety

1.2. Be careful when handling hot surfaces.

2.Materials

2.1. Calphalon Non-stick Roasting Pan with its rack (anodized aluminum – 16 x13 x 4 in.)
2.2. Thermometers/thermocouples
  2.2.1. Type J or K Thermocouple – Calibrate prior to use
  2.2.2. Type J or K insulated wire
    2.2.2.1. The thermocouple type and wire type must be the same (ie: if Type J wire is used the appropriate Type J Thermocouple Thermometer must be used)
2.3. Digital Scale
  2.3.1. Calibrate daily
  2.3.2. Record to the nearest 0.1 g
2.4. Beef Samples (Frozen, -20°C)
  2.4.1. Beef, Loin,Tenderloin Roast
2.5. Stainless Steel tongs or 2 – stainless steel spatulas for removing the hot roast from the roasting pan
2.6. Wire racks to rest the cooked product on
2.7. Data Collection Form for Roasting
  2.7.1.*Data4-Cooking.NDI.P3 01-Dec-2010*
    2.7.1.1. Table 1 outlines the specific data points to be collected on the Data 4 form.
2.8. Identification tags – Polyester Paper (Xerox Item No. 3R12363)

3.Beef Preparation before Cooking

3.1. Temper frozen raw samples in original package as a single layer under refrigeration (0-4°C) for 24-48 h based on the appropriate size and weight of the cut; record tempering start and stop date and time.

3.1.1. Record Internal temperature of product (*Initial Temp*) should not exceed 5°C (41°F) (for thawed product).

3.2. Remove roast from its package and purge and blot with a paper towel.

3.3. Record raw weight and initial internal temperature of product.

3.4. Apply the thermocouple in the geometric center, or thickest portion, of the roast within the roasting pan. Thermocouple positioning should not affect product's contact with the cooking surface and may not be possible with small or thin beef cuts. In this case, use a thermocouple to periodically check internal temperature of samples throughout the cooking process.

3.4.1. Double check with a probe to ensure that the temperature captured on the thermocouple is accurate upon removing the roast from the oven

4.Pre-heating Oven

4.1. Position oven rack so that beef sample will be in the center of the oven.

4.2. Preheat oven 10 minutes at 160°C (325°F). Assess temperature. Adjust heat level if necessary. Continue to preheat an additional 5 minutes or until desired temperature is reached.

4.2.1. Record actual oven temperature from a calibrated oven thermometer before roasting begins.

5.Cooking

5.1. Position beef sample in the center of the rack in the roasting pan bone/boned side down.

5.2. Do NOT add oil or water. Do NOT cover.

5.3. Position roasting pan with beef sample on oven rack in center of oven.

5.3.1. Two roasts may be placed in the oven at the same time if the oven rack will accommodate two roasting pans.

5.4. Roast to internal temperature of 60°C (140°F). Observe cook temperature and cook time as needed throughout cooking.

5.5. Remove roasting pan from the oven.

5.5.1. Record the time removed (*Removal Time*) and internal product temperature (*Removal Temp.*) when removed from the oven.

5.5.2. Carefully remove the roast and the rack that it was cooked on from the pan and place at room temperature. Continue to monitor temperature until the peak internal temperature (*Peak Temp*) is reached.

5.5.2.1. The roast may remain on its original rack as long as it is removed from the roasting pan. Or, the roast can be place on a different wire rack.

5.6. Record peak internal temperature of the roast and the time this temperature was achieved.

5.6.1.1. The point right before the temperature declines (highest temperature reached) is the peak final internal temperature of the cooked sample.

5.7. Record cooked weight (*Cooked Weight*) of product to the nearest 0.1 g, 30 minutes after the product is removed from the oven.

6.Post-cooking (Stand-time)

6.1. Allow beef samples to chill uncovered under refrigeration (0-4° C) for 12 - 24 hr before dissection.

6.1.1. Assure all ID tags are secure in order to maintain product identification.

Beef Nutrient Database Improvement Study
SOP 6.3

DISSECTION OF RAW AND COOKED RETAIL CUTS

1. Purpose

1.1. To describe the procedure for dissection of raw and cooked beef retail cuts from the **loin and round**

2. Safety

2.1. Be careful when handling sharp instruments.
2.2. Be careful when handling raw product; wash hands thoroughly after dissecting raw product.

3.Materials

3.1. Digital Scale
3.1.1. Calibrate daily
3.1.2. Weigh to the nearest 0.1 g
3.2. Cutting board(s)
3.3. Non-latex, non-powdered, disposable examination gloves
3.4. Disposable scalpels – Fisher Catalog # S17800
3.5. Data Collection Form (Data6-Dissection.NDI.P3) – See Table 1
3.6. Data Reporting Spreadsheet (T6-Dissection.NDI.P3)
3.7. Weigh Boats and/or wax paper
3.8. Beef Samples - Raw (Chilled, 0 ± 4 °C)
3.8.1. Beef Loin Porterhouse Steak (U.P.C. 1330/2145)
3.8.2. Beef Loin T-Bone Steak (U.P.C. 1369/2184)
3.8.3. Beef Loin Bnls Top Loin Steak, 1/8" trim (U.P.C. 1404)
3.8.4. Beef Loin Bnls Top Loin Steak, 0" trim (U.P.C. 1404)
3.8.5. Beef Loin Tenderloin Roast (U.P.C. 1386)
3.8.6. Beef Loin, Tenderloin Steak, side muscle off (U.P.C. 1395)
3.8.7. Beef Round, Eye of Round Steak (U.P.C. 1481)
3.8.8. Beef Round Eye of Round Roast (U.P.C. 1480/2295)
3.8.9. Beef Round Top Round Steak (U.P.C. 1553/2368)
3.8.10. Beef Round Top Round Roast (U.P.C. 1455)
3.8. Beef Samples - Cooked (Chilled, 0 ± 4 ºC)
3.8.1. Beef Loin Porterhouse Steak (U.P.C. 1330/2145)- grilled
3.8.2. Beef Loin T-Bone Steak (U.P.C. 1369/2184)- grilled
3.8.11. Beef Loin Bnls Top Loin Steak, 1/8" trim (U.P.C. 1404)- grilled

3.8.3. Beef Loin Bnls Top Loin Steak, 0" trim (U.P.C. 1404)- grilled
3.8.4. Beef Loin Tenderloin Roast (U.P.C. 1386)- roasted
3.8.5. Beef Loin Tenderloin Steak, side muscle off (U.P.C. 1395)- grilled

3.9. Fat Samples-Raw
3.9.3. External Fat
3.9.4. Seam Fat

3.10. Fat Samples-Cooked
3.10.3. External Fat
3.10.4. Seam Fat

3.11. Identification tags – Polyester Paper (Xerox Item No. 3R12363)- *recommended*

4.Meat Preparation Before Dissection

4.1. Temper frozen raw samples as a single layer in refrigeration (0-4°C) for at least 24 hr based on size and weight of the cut.
4.1.1. Record tempering date, start time (military) and location.

4.2. Temper cooked samples as a single layer in refrigeration (0-4°C) for 12h post cooking.
4.2.1. Record tempering date, start time (military) and location.

4.3. Record internal temperature of product. Should not exceed 5°C (for raw product).

4.4. Remove cut from vacuum package and blot surface to remove excessive surface moisture.

4.5. Weigh intact cuts of a single sample individually. (i.e. Obtain and record weights for ***each individual*** steak comprising sample 24B-Right)
4.5.1.Weigh each cut twice to assure accurate initial weight is recorded

5.Dissection

5.1.DISSECTION COMPONENT DEFINITIONS (Jones et al., 1992).SEE ILLUSTRATIONS 1-4.
5.1.1.<u>Refuse (waste):</u> Includes all bone and heavy connective tissue
5.1.1.1.<u>Heavy Connective tissue:</u> connective tissue perceived by trained dissectors as inedible and would eventually be trimmed from a retail cut before being consumed.
5.1.2.<u>Separable Lean:</u> to include all muscle, intramuscular fat and any "light" connective tissue considered edible.
5.1.3.<u>External Fat:</u> Includes adipose tissue located on the outer surface of the cut, above the bridge of the muscles (See Illustrations)

5.1.4. Seam fat: Includes the fat deposited between muscles in a cut and may extend to the outer portion of the cut as a result of fabrication (See Illustrations).

5.2.DISSECTION OF THE RETAIL CUT

5.2.1. Record date of dissection (MM/DD/YY)

5.2.2. Record the start time (military) of dissection for each cut.

5.2.3. Blot surface of cut prior to recording initial weight.

5.2.4. Dissect and weigh one sample at a time so that samples will not be mixed.

5.2.5. Wear non-latex gloves (no powder)

5.2.6. Record initial product weight and internal temperature of the single sample. Defined as the weight of *individual* cut making up a sample.

5.2.6.1.Raw samples – Post 24-48 h tempering of the frozen raw retail cuts, record product weight of the single sample. Defined as the weight of *individual* cut making up a sample.

5.2.6.2.Cooked samples – Post 12-24 h tempering of the cooked retail product, record initial cooked product weight prior to dissection. Defined as the weight of *individual* cut making up a sample.

5.2.7. Using a boning knife or scalpel, separate any connective tissue, lip lean/fat (where applicable), seam fat, and external fat from the lean of the meat sample.

5.2.8. Place wax paper, or alternative "cover", over dissectible components during dissection.

5.2.9. Weigh each component of the dissected retail cut and record on data sheet.

5.2.10. Place dissected lean components in Ziploc® bags with proper identification and hold in cooler (0°- 4° C) for same-day homogenization.

5.2.11. Homogenization of the separable lean shall occur the **same day** as dissection

5.2.12. Dissected fat shall be separated and homogenized as follows:

5.2.12.1.1.Seam fat Raw and Seam fat Cooked

5.2.12.1.2.External fat Raw and External fat Cooked

*NOTE: A composited 500g sample of both raw and cooked fat will be sent to TTU (**See Compositing SOP**).

5.3.WEIGH DISSECTED SAMPLES

5.3.1. Scale considerations

5.3.1.1.All scales should be calibrated each day

5.3.1.2.Scale should be on level surface.

5.3.1.3.Take weight to the nearest 0.1 gram.

5.3.1.4.Zero scale before each weight.

5.3.1.5.Blot surface of cut before measuring weight.

5.3.1.6.Use wax paper to cover scale surface prior to weighing.

5.3.1.7.Record weight in appropriate space on approved NDI data sheet

5.3.1.8.Wipe residue from weigh pan after each weight

5.3.2. Yield tolerance must be recorded at time of dissection and meet tolerance levels below.

5.3.2.1. 97.0 – 101.0 % recovery tolerance

5.3.2.2.**Corrective Action when Yield tolerance is not met:**

5.3.2.2.1.If yield tolerance is not met, re-calibrate scales

5.3.2.2.2.Assure that all separable components have been removed from cutting board and instruments and re-weigh components.

5.3.2.2.2.1. If tolerance is then within range, record new data.

5.3.2.2.3.If not within yield tolerance, exclude lean from homogenate and indicate failure to meet yield tolerance on datasheet.

5.4.IDENTIFICATION OF CUTS

5.4.1. All cuts will be labeled with proper identification tags.

5.4.1.1.Refer to Sample Tag - C

6.Data Collection and Reporting

6.1. Dissection data shall be collected on the official NDI data collection form "Data6-Dissection.NDI.P3.

6.2. Following dissection the data collected on Data Form 6 shall be entered in the official NDI dissection spreadsheet and submitted to the project tracking manager (PTM) following university QC check.

ID TAGS FOR DISSECTED AND HOMOGENIZED RETAIL CUTS **SAMPLE TAG - C**

1. Project # (28150-P2)
2. Date carcass collection
3. University (AM, CS, TT)
4. Animal # (1-36)
5. Carcass A or B
6. Side of carcass (R/L)
7. Cut ID Code
8. Cooked (C) / Raw (R)
9. If cooked, cooking method (G-grilled, R-roasted)
10. Purpose (proximate, back up, composite)

28150-P3	**6/15/11**
TT-24-B-R-31BLPHS-C-G	
PROX	

Table 1 – Dissection data points for raw and cooked cuts (Data6-Dissection.NDI.P2)

Data Point	Description of Data Point
1	Study # (28150-P3)
2	Univ (AM, CS,TT)
3	Animal(1-36; a/b)
4	Side (R/L)
5	Carcass Collection Date (mm/dd/yy)
6	ID Code[1]
7	Cut
8	Steak Number or Roast Location
9	Cook Method (Grill,Roast)/Raw
10	Cooler Location
11	Cooler Temp[2]
12	Date Placed in Cooler (mm/dd/yy)
13	Time Placed in Cooler (Military Time)
14	Date of Dissection (mm/dd/yy)
15	Time of dissection (Military Time)
16	Internal Temp at Dissection[2]
17	Raw, Retail Cut Weight[3] or Tempered Cooked Cut Weight[4]
18	Lean[4]
19	Seam Fat[4]
20	External Fat[4]
21	Refuse[4]
22	Yield of Dissection Weights[5]

[1]See ID Code list

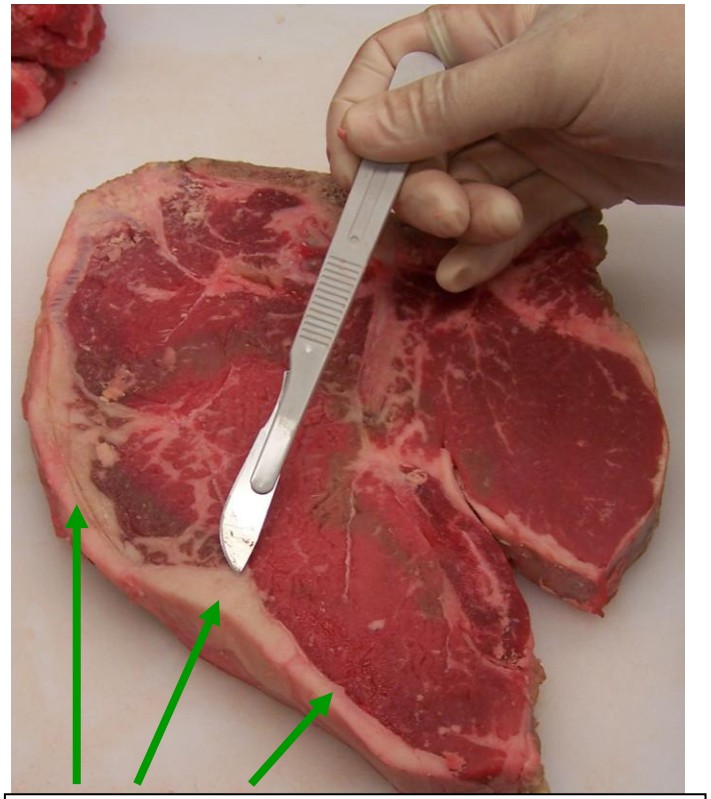
[2]Record temperature in ^{o}C

[3] Remove cut from its package and its purge; weigh cut to the nearest 0.1g

[4] Record weights to the nearest 0.1 kg

[5] Yield of Dissection Weights = (Sum of Lean, Seam Fat, External Fat, Refuse)/Intact cut weight

Figures 1-2. Dissection of Beef Porterhouse Steak



External Fat- located on the outer surface of cut

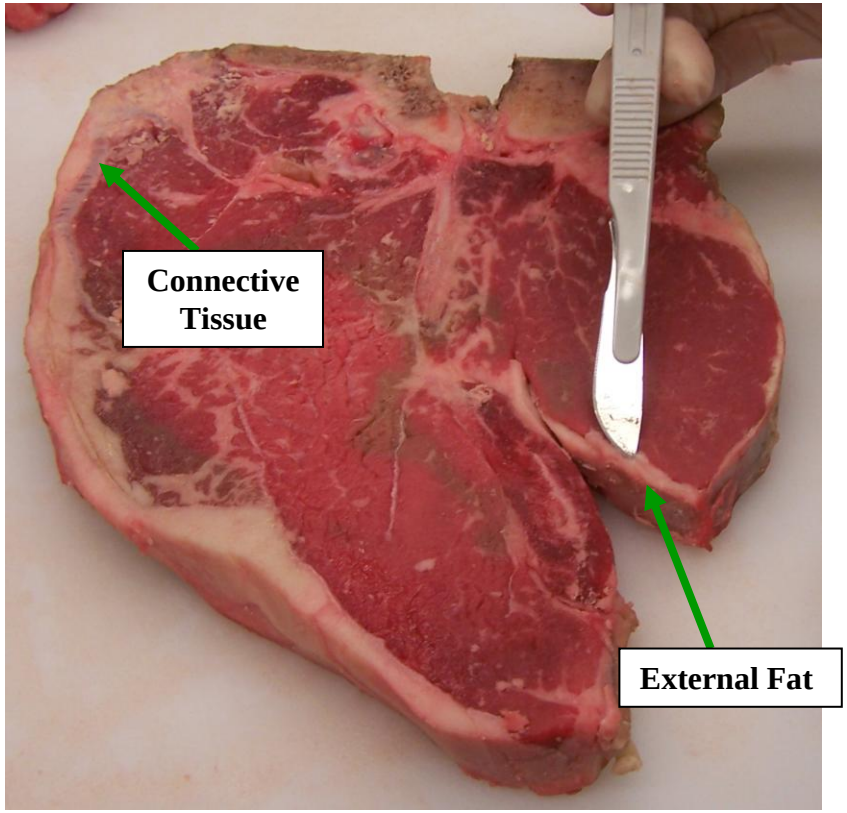
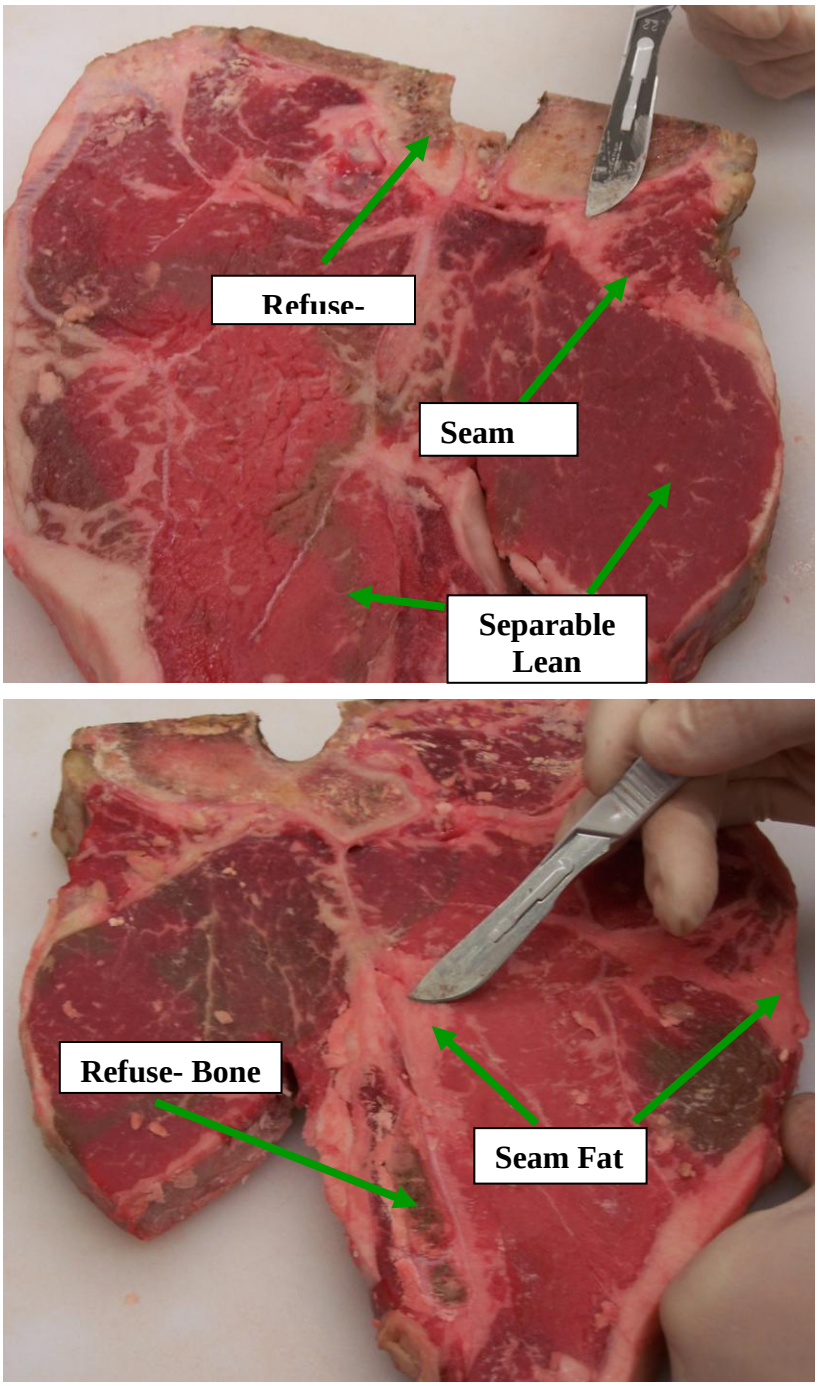
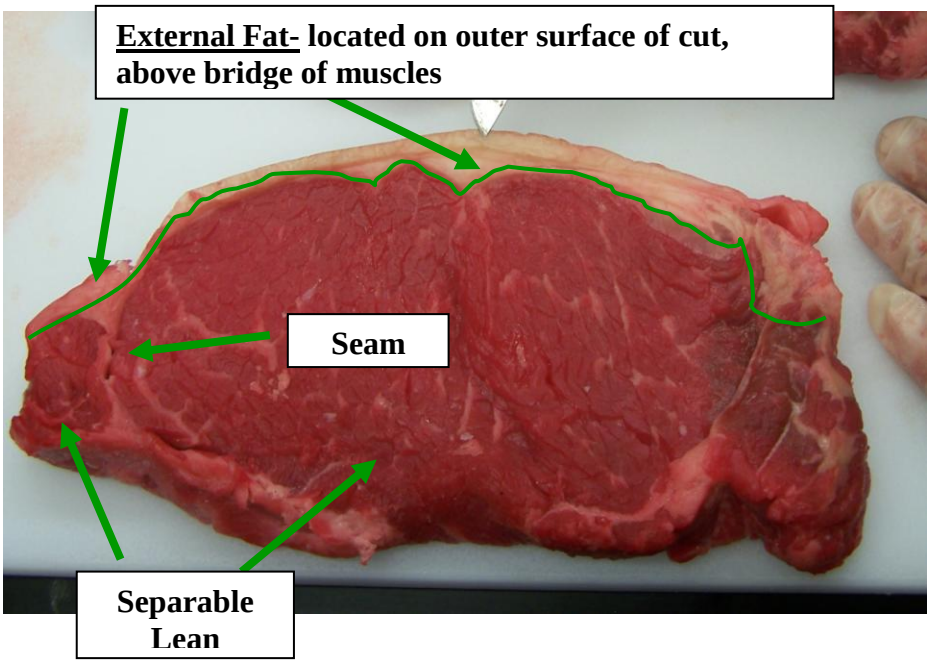
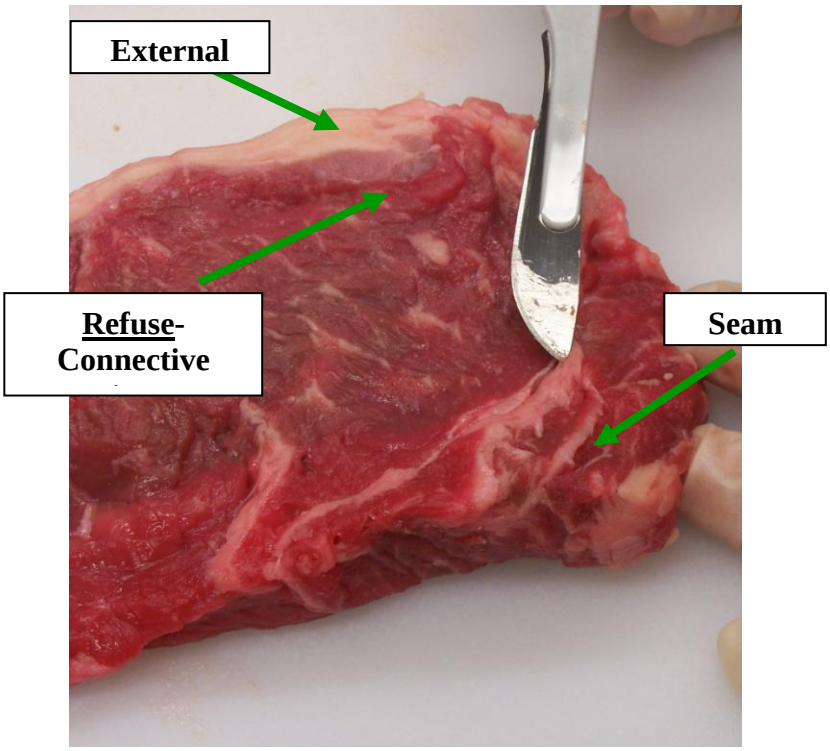


Figure 3-4: Dissection of Porterhouse Steak

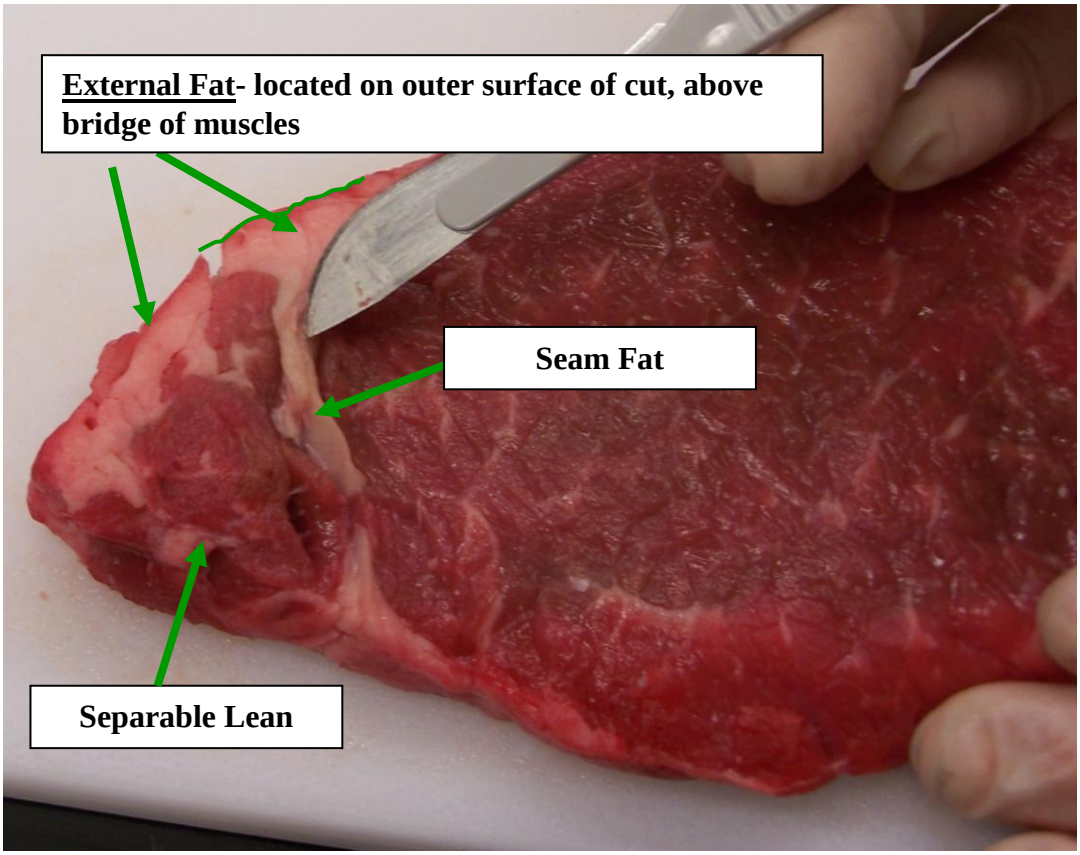


Figures 5-6: Dissection of Top Loin Steaks- 1/8" Trim





Figures 7: Dissection of Beef Top Loin Steak- 1/8" Trim



Figures 8-9: Dissection of Beef Top Round Roasts

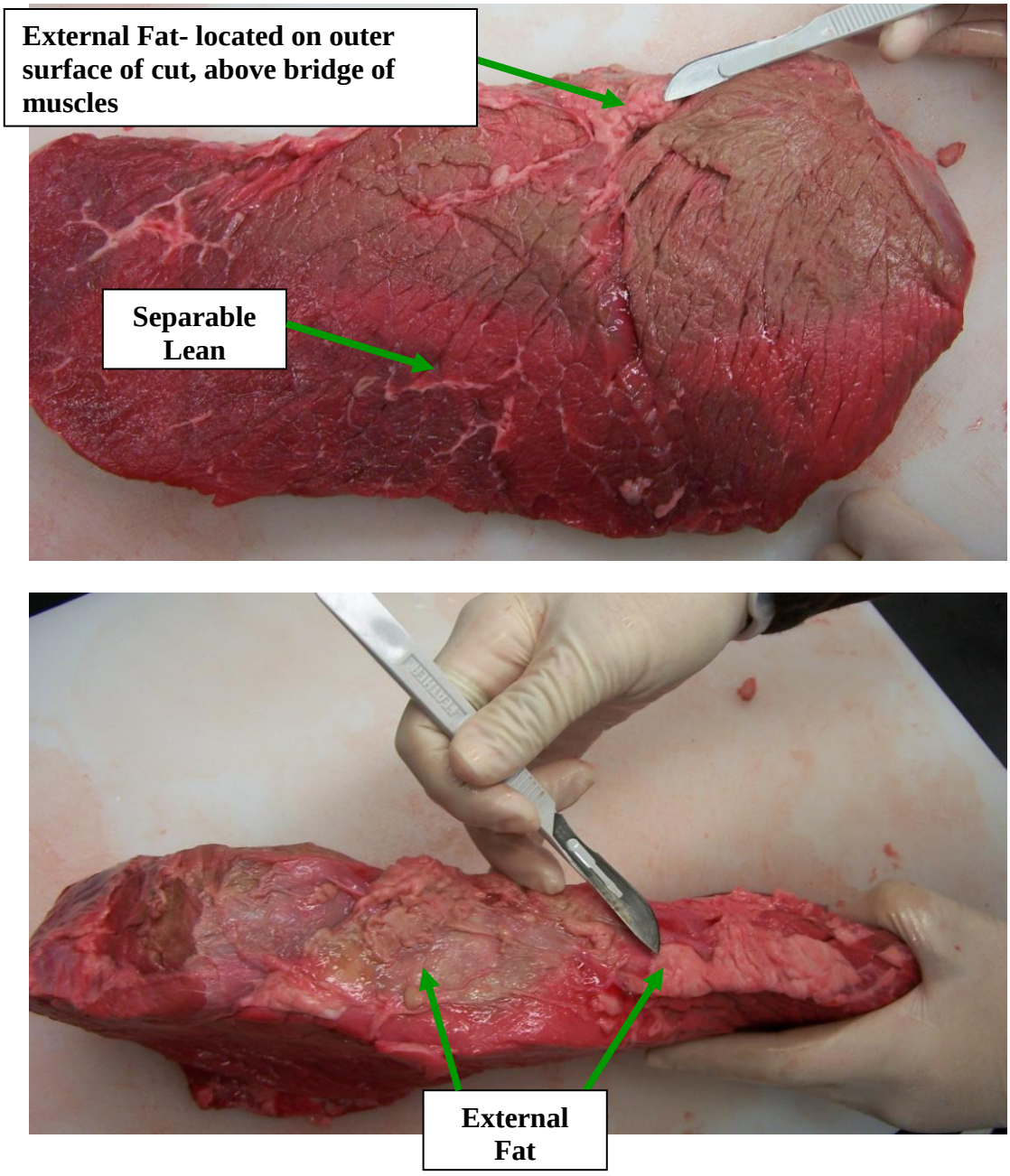
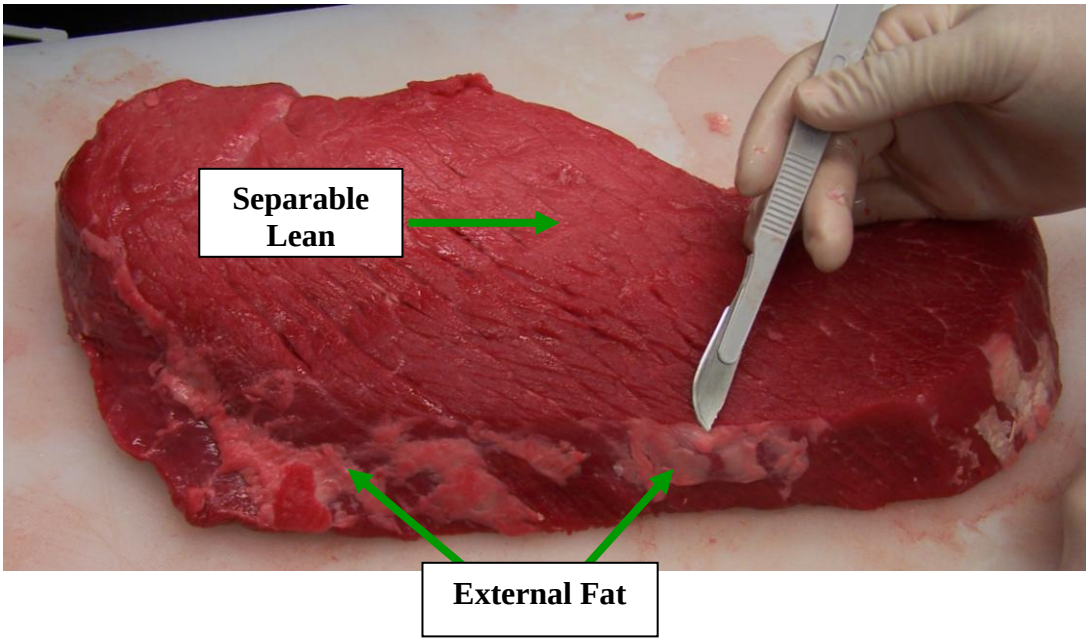


Figure 10: Dissection of Top Round Steak



Beef Nutrient Database Improvement Study
Standard Operating Procedure

HOMOGENIZATION OF BEEF RETAIL CUT SAMPLES

NOTE: All homogenization must be done in the absence of direct light.

1. Purpose

To describe the procedure for preparing and homogenizing raw and cooked beef samples.

2. Safety

2.1 Be careful when handling the Robot-Coupe 7 blade-it is very sharp.
2.2 Cryogenic gloves, lab coat and safety goggles must be worn when handling liquid nitrogen.

3.Materials

NOTE: All utensils and equipment used in homogenization must be thoroughly cleaned and dried between each sample to assure there is no cross-contamination of materials that would affect nutrient analysis.

3.1 Robot Coupe Blixer 7 BX 6V batch processor (M1-45-3) or other approved blending/homogenizing device
3.2 Dissected and cubed beef samples to be homogenized
3.3 Freezer (-80 ± 5° C ULTRA LOW TEMP)
3.4 Digital thermometer (Fisher Cat #15-078J) or equivalent
3.5 Whil-pak bag or equivalent
  3.5.1 2 oz (Fisher cat# B01009)
  3.5.2 4 oz (Fisher cat# B00679)
  3.5.3 18 oz (Fisher cat# B00736)
3.6 Gallon size freezer Ziploc bags
3.7 11-13/16" Ellipso-Spoon J spatula (Fisher Cat #14-375-57), or equivalent
3.8 Permanent, cryogenic marker (Fisher Cat #13-382-52), or equivalent
3.9 Teri Wipers (Fisher Cat #15-235-61), or equivalent
3.10 Powder-free nitrile gloves (Fisher Cat #18-999-4099), or equivalent
3.11 Ice bucket (Insulated bucket capable of withstanding liquid N), at least ~2 quarts size
3.12 One (1) medium (7-quart) stainless steel bowl

3.13 Cryogenic labels preprinted with sample numbers (Avery #5520), or equivalent
3.14 Large siliconized Rubbermaid spatula or equivalent
3.15 Analytical balance (M1-39-9 or M1-42-3, Fisher #01-913-317), or equivalent
3.16 Liquid nitrogen
3.17 Large stainless steel spoon
3.18 Safety goggles
3.19 Lab coat
3.20 Cryogenic gloves
3.21 Data sheet
3.22 Protocol

4. Procedure

4.1 Prepare for homogenization

Note: It is extremely important to protect the samples from contamination. Do not touch utensils or equipment that comes in contact with the sample. Wear clean, powder-free nitrile gloves when working with utensils, equipment and samples.

Note: All homogenization must be done in the absence of direct light to prevent nutrient loss.

4.2 Homogenize the sample

Note:Wear powder-free gloves throughout the homogenization procedure.

Note:Always use the same balance throughout the entire procedure.

4.2.1 Raw Lean Samples

4.2.1.1 Remove the samples to be homogenized from the –18°C freezer. Allow the samples to thaw in the refrigerator (0°C 4°C) for 24-48 h. When samples are thawed, the retail cut shall be dissected according to SOP 6.2 (Dissection) into separable lean and separable fat. Once dissection is complete, proceed to the homogenization procedure.

4.2.2 Cooked Lean Samples

4.2.2.1 Remove the samples to be cooked from the –18°C freezer. Allow the samples to thaw in the refrigerator (0°C to 4°C) for 24-48 h. When samples are thawed, the retail cut shall be cooked according to study protocol. Cooked samples will be tempered for 24 h (0°C to 4°C) prior to dissection into separable lean and separable fat. Once dissection is complete, proceed to the homogenization procedure.

4.2.3 Fat Samples

4.2.3.1 Fat samples will be homogenized by each university per cut and type. Dissected fat samples should be separated into four groups as follows and sent to TTU for compositing for the entire loin and round(fat data will not be analyzed on a cut by cut basis). **Keep the 4 fat groups from each cut separate.**

-external fat, raw
-external fat, cooked
-seam fat, raw
-seam fat, cooked

<u>Note</u>:The total time necessary to complete steps 4.2.4 through 5.1 must not exceed two hours. If the time limit is exceeded, notify a supervisor and record the deviation on the homogenizing lab form

4.2.4 Following completion of dissection of cooked and raw samples, reserve samples in refrigeration (0°C to 4°C)

4.2.5 Prior to homogenization, place Robot Coupe 7 bowl in -80 freezer.

4.2.6 Record starting time on form.

4.2.5 Fill ice bucket with liquid nitrogen to fill line.

4.2.6 Carefully transfer sample to the ice bucket while stirring with stainless steel spoon to avoid pieces freezing to the bottom and sides of the bucket. Using the stainless steel spoon, check that all of the pieces are completely frozen. If they are not, add more liquid nitrogen in increments until the composite is completely frozen. Drain the liquid nitrogen into another bucket.

4.2.7 Transfer the frozen sample from the ice bucket into the Robot Coupe 7 bowl. (store bowl in -80 freezer until needed)

Note:Do not place more than 2500 grams of beef into the Robot Coupe 7 bowl.

4.2.8 Set the speed setting on the Robot Coupe 7 to 1500 rpm. Blend the composite for 10 seconds by turning on the power switch.

4.2.9 Turn off, then turn switch to 3500 rpm.

4.2.10 Blend the sample for 30 seconds at 3500 rpm by turning on the power switch of the Robot Coupe 7.

4.2.11 Remove the Robot Coupe 7 lid and scrape any material adhering to the lid back into the Robot Coupe 7 bowl using the large siliconized Rubbermaid 7 spatula. Scrape the residue off the spatula on the inside of the Robot Coupe 7 bowl.

4.2.12 Repeat steps 4.2.12 through 4.2.13. If the contents of the Robot Coupe 7 bowl appear to be homogeneous, proceed to step 4.2.15. Contents should be in fine powdered form free of chunks, etc. If not, repeat steps 4.2.12 through 4.2.13. If needed, store homogenized samples in -80 freezer before aliquoting.

4.2.13 Transfer the contents of the Robot Coupe 7 bowl to a clean medium stainless steel bowl using the large stainless steel spoon. Immediately place the bowl into a bucket with liquid nitrogen.

4.2.14 Using the stainless steel spoon, stir the sample in the following manner; start at the outer edge of the bowl and work toward the center and then back out again in a smooth motion. Repeat the stirring pattern for 30 seconds.

4.3 Aliquot into sample bags for proximate analysis and for compositing.

4.3.1 Using the Ellipso-Spoon J spatula, fill a Whirl-pak bag with the required amount for sampling – Record proximate and back-up weights (tare scale for bags or weigh bags and subtract bag weight)
4.3.1.1 Proximate analysis a ***minimum of 60 grams*** for all cuts (unless noted below)

4.3.1.1.1 Please note that individual animal proximate will not be collected for the following (Table 1):

- RAW 33BLTLSB-0
- RAW 35BLTS
- RAW and COOKED 36BRERS
- COOKED 37 BRERR
- RAW and COOKED 38BRTRS
- COOKED 39BRTRR

4.3.1.2 Proximate Back-up and Archive = 100 grams each

Note: 100 g of sample may not be attainable for cuts with less total product weight. For those cuts, Proximate Back-up and Archive will be aliquoted after Proximates and Total Fat (TTU only) aliquots have been made. Divide half of remaining sample into Proximate Back-up and Archive.

Note: Proximate back-up samples will not be collected for 34BLTLSB-0 (RAW), 35BLTS (RAW), 36BRERS (RAW and COOKED), 37 BRERR (COOKED), 38BRTRS (RAW & COOKED), and 39BRTRR (COOKED) (Table 1).

4.3.2 Make sure there is no sample residue on the opening or on the outside of the bags. Clean the bags with a Teri Wiper 7 if necessary.

4.3.3 Fold each sample bag and seal. Be sure to press out all air.

4.3.4 Place sample bag inside 18oz Whirl-pak bag, fold and seal. Store in -80°C freezer until ready for proximate analysis.

4.3.5 Aliquot 450 grams from the remainder (for each animal) into a Freezer Ziploc Bag that is properly labeled with the sample identification; remove all air and seal securely. This sample is for compositing and will be referred to as "For Composite".

Note: "For Composite" aliquots will not be collected for 33BLTLSB-0 (RAW), 35BLTS (RAW), 36BRERS (RAW) and 38BRTRS (RAW) (Table 1).

4.3.5.2.1 Aliquot remaining sample accordingly

4.3.6 Record "For Composite" sample weight (tare scale for bags or weigh bags and subtract bag weight).

4.3.7 Place "For Composite" sample inside another Ziploc Bag and seal. The "For Composite" sample will be shipped to Texas Tech University for compositing.
4.3.7.1 See NDI Shipping SOP#9

4.3.8 Aliquot another 450g from the remainder that is left after the sample "Composite Backup/Archive". This remainder that is left should be double Ziploc bagged and stored in the -80°C freezer. This remainder, referred to as "Backup/ Archive" may be used for compositing and will be shipped to TTU if shipping errors occur from the "For Composite" sample.

Note: 450 g may not be attainable for all cuts, in this case, Backup/Archive will consist of one –half of remaining sample (additional half used for Proximate Back-up) after all aliquots have been made (PROX, "For Composite")

4.3.9 Record weight of the remainder of sample- referred to as "Backup Archive" (tare scale for bags or weigh bags and subtract bag weight).

4.3.10 Record end time of homogenization of a single animal on the data sheet upon storage.

6. Storage

6.1Make sure each bag is tightly sealed. Store the samples kept for proximates, backups, and archives in the - 80°C ± 5°C ultra-cold freezer until needed for proximate analysis. Record end time on form.

6.2Complete Form

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